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REVIEW
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SERIES A.

VOL. 30. 1942.

MCKENZIE (H. L.). **Injury by Sugar Pine *Matsucoccus* Scale resembles that of Blister Rust.**—*J. For.* **39** no. 5 pp. 488–489, 1 ref. Washington, D.C., 1941.

A species of *Matsucoccus* observed in 1936 and subsequent years to be damaging sugar pine (*Pinus lambertiana*) in California was described by Morrison in 1939 as *M. paucicicatrices*. It also occurs on western white pine (*P. monticola*) and limber pine (*P. flexilis*) and has been collected from various localities in California, Oregon, Montana and Wyoming. The Coccids tend to congregate at the nodes of branches of *P. lambertiana*, and a heavy infestation results in a swelling of the tissues, cracking of the bark and a flow of resin, which tends to drown the insects and to kill the branch by forming a resined lesion at the node. The needles of infested branches usually begin to fade in spring; they turn pale green, straw coloured, and finally deep sorrel, but remain on the stem throughout summer and autumn and often until the following year. In certain areas infestations are common on the trunks of young trees, particularly in the upper crowns. Trees from sapling to pole size are weakened as a result of attack; they may be killed, but are usually deformed, owing to the killing of terminal and lateral branches. Trees growing close together, on poor sites, or under a canopy, appear to be particularly susceptible to attack. *M. paucicicatrices* also damages the crowns of mature pines, but appears to have less effect on these, though it may possibly render them more liable to attack by bark-beetles.

It is stated in a note by W. W. Wagener that the injury produced by this Coccid on *P. lambertiana* is very similar to that caused by white pine blister rust [*Cronartium ribicola*]. The close resemblance between the two forms of injury, particularly in the early stages, materially increases the difficulty of determining centres of infestation by the rust on *P. lambertiana*.

WHITCOMB (W. D.). **Biological Control of Mealybugs in Greenhouses.**—*Bull. Mass. agric. Exp. Sta.* no. 375, 22 pp., 2 figs., 23 refs. Amherst, Mass., 1940.

The following is taken from the author's summary. *Cryptolaemus montrouzieri*, Muls., has been reared on *Pseudococcus citri*, Risso, and

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P. adonidum, L. (*longispinus*, Targ.) on gardenia and on *Phenacoccus gossypii*, Tns. & Ckll., on chrysanthemum under normal conditions in greenhouses in Massachusetts [*cf. R.A.E.*, A **24** 492; **25** 719; **26** 648]. In experiments, the average *Cryptolaemus* larva ate about 1,325 eggs of *Pseudococcus citri*, the equivalent of three or four egg-masses, during its life, and completely eradicated an average egg-mass in nine or ten days. A constant temperature of 60°F. definitely retarded the development and activity of the Coccinellid, so that it did not control the mealybug, but satisfactory results were obtained at 70 and 80°F. Practical control of mealybugs by it in greenhouses was obtained only between 1st April and 1st September, when a temperature above 70°F. could be maintained; when the mealybugs were numerous enough to provide adequate food without causing unprofitable injury to the plants; on plants that would tolerate the warm growing conditions; when the adults were liberated at the rate of one to each gardenia plant or one to each two chrysanthemum plants; and when the insecticides necessary for the control of other pests did not kill a high percentage of the Coccinellid. Under these conditions, though the larvae that developed from the liberated beetles did not give economic control, the second generation practically eradicated heavy infestations of mealybugs within 9–10 weeks of the liberation.

English (L. L.) & Turnipseed (G. F.). **Insect Pests of Azaleas and Camellias and their Control.**—*Circ. Ala. agric. Exp. Sta.* no. 84, 18 pp., 13 figs., 1 ref. Auburn, Ala., 1940.

This circular comprises notes on the appearance, bionomics and control of the insects and mites injurious to azaleas and camellias in Alabama. The azalea insects are dealt with first. *Stephanitis pyrioides*, Scott, is a major pest and causes considerable damage even if present in only small numbers. The adults and nymphs feed on the lower surface of the leaves, causing them to become spotted with grey or blanched; in addition the leaves are disfigured by the varnish-like excrement and the exuviae. The eggs, which are deposited in the tissue of the leaves, hatch after 20–25 days, the nymphs mature in 10–20 days, and the females begin to oviposit 5–7 days later. Adults survived for three weeks in the insectary. Eggs deposited in autumn begin to hatch in February under favourable conditions. The best control was given by a spray containing 1 U.S. gal. white-oil emulsion and 1½ lb. powdered derris root with a rotenone content of not less than 4 per cent. in 100 U.S. gals. water. Plants in gardens should be sprayed in early spring, again after flowering, and for a third time at the end of September; where infestation is only moderately severe, the first application can be omitted. For the eradication of infestation in nurseries, applications should be made every three weeks. An oil spray containing nicotine sulphate was less satisfactory, and nicotine and derris dusts were ineffective.

Light infestations of *Eriococcus azaleae*, Comst., are of little importance, but where attack is severe, the plants may be defoliated or destroyed, and their value reduced by the sooty mould that grows on the honey-dew excreted by the Coccids. The females and eggs usually occur in forks of the branches and twigs, and the males on the lower surface of the leaves. There are two generations a year, the eggs hatching in April–May and September. Sprays containing 1½ U.S. gals. white-oil emulsion with the addition of either 1½ lb. derris or

1 U.S. pint nicotine sulphate in 100 U.S. gals. water gave excellent control, but since the females and eggs are very resistant, the applications should be made just after the hatching periods are over. This Coccid is parasitised by *Coccophagus immaculatus*, How., which, however, does not exert practical control.

Heliothrips haemorroidalis, Bch., sometimes causes severe damage to the leaves ; the areas attacked become dry and pale, and defoliation may occur. The eggs, which are deposited in the leaf tissue, hatch in 4–8 days. The nymphs are gregarious, and complete their development in 15–25 days. Both adults and eggs appear to overwinter. This thrips can be controlled by incorporating nicotine sulphate (1 : 800) in sprays against other insects ; in greenhouses, frequent applications should be made and a wetting agent should be included if the spray does not contain oil. Derris is less effective than nicotine.

Pseudaonidia paeoniae, Ckll., occurs on the twigs and branches and may cause the foliage to become thin and twigs and even larger branches to die, but often infests only one or two bushes in a planting. There is one generation a year, and the eggs hatch during April and May. Effective control is obtained by a spray of 2 gals. white-oil emulsion in 100 gals. water applied as soon as the eggs have hatched. *Aleurodes azaleae*, Baker & Moles, is a minor pest and may attack only a few bushes in a large planting. The nymphs feed on the lower surface of the leaves and are controlled by a spray of 1½ gals. oil emulsion in 100 gals. water. This spray is not effective against the adults and should be applied in early spring before they emerge. *Gracilaria azaleella*, Brants, is unimportant on outdoor plants but may cause considerable damage to cuttings in greenhouses. Eggs are deposited singly on the underside of the leaf and hatch in about four days. The larva first makes a blister-mine in a leaf and then emerges and rolls the tip of another leaf to form a shelter in which it feeds and pupates. A spray containing 1 oz. lead arsenate in 2 U.S. gals. water is recommended for control. Occasional damage to the leaves is caused by adults of *Colaspis favosa*, Say, which can be destroyed by derris dusts.

Paratetranychus ilicis, McG., is a major pest of both azalea and camellia ; severe infestations result in the discoloration of the upper surfaces of most leaves and partial defoliation. Eggs are deposited chiefly on the lower surface of the leaves and hatch in 4–7 days in warm weather. The mites feed on both leaf surfaces, mature in 6–7 days, and begin to oviposit 1–5 days later. A species of *Tetranychus* is often associated with *P. ilicis* on azalea, but is of less importance. It completes its life-cycle in about a fortnight and feeds in restricted areas, covered by a fine web, on the lower surface of the leaves, causing a reddish discoloration on the upper surface. Both mites are generally injurious only in cool weather, but under favourable climatic conditions infestation may extend into the summer. Control measures comprise applications, at the beginning of October and sometimes again in spring after the plants have flowered, of 1½ gals. white-oil emulsion in 100 gals. water. Summer infestations can be checked by means of sulphur dusts.

Of the insect pests of camellias, the most important is *Fiorinia theae*, Green, which is generally confined to the lower surface of the leaves. As a result of its feeding, yellow patches appear on the upper surface, the whole leaf may become discoloured and drop prematurely, the production of flowers is impaired, and infested cuttings often die before developing roots. The females deposit 10–16 eggs, which hatch

in 7–21 days, and the crawlers migrate to younger growth. The complete life-cycle occupies 60–70 days, and hatching takes place to some extent throughout the year and is continuous from March to November. *Lepidosaphes camelliae*, Hoke, may severely damage young plants and cuttings, causing the leaves to drop prematurely. The females deposit 25–55 eggs, which hatch in 11–24 days, and the complete life-cycle usually occupies 60–70 days. All stages are present throughout the summer, but few larvae hatch between October and March except in greenhouses and cold frames. *L. camelliae* is attacked by Coccinellids and by a Hymenopterous parasite. Other Coccids that infest camellia are *Parlatoria pergandei*, Comst., *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.), *Coccus hesperidum*, L., and *Pseudaonidia paeoniae*. All these Coccids can be controlled by sprays of 2 gals. white-oil emulsion in 100 gals. water applied in spring after the flowering period ; two or more applications may be necessary if infestation is heavy.

Aphis gossypii, Glov., sometimes attacks the new leaves, causing them to curl and producing honey-dew that favours sooty mould. It can be controlled with dusts containing 3 per cent. nicotine or a spray of nicotine sulphate (1 : 800) and soap. *Eriophyes* sp. causes the foliage to turn brown in warm weather ; it is readily controlled by sulphur dusts.

Notes on suitable types of spraying equipment and spray formulae and programmes for use on azaleas and camellias are appended. Spraying should not be performed in winter, in summer when the temperature is likely to rise above 95°F., or on plants suffering from lack of moisture or of cultivation.

PARKS (T. H.). **The Wheat Field Survey for 1940.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **25** no. 206 pp. 147–150, 3 figs. Wooster, Ohio, 1940.

The average infestation of wheat by *Mayetiola* (*Phytophaga*) *destructor*, Say, in Ohio was reduced to 4 per cent. of the straws in 1940 [*cf. R.A.E.*, A **28** 223], though there was considerable variation between individual fields even in the same district. The heaviest infestations were usually found in fields that had been sown earliest. Winter barley and wheat should not be sown before the correct dates, which are shown on a map, but it is now considered safe to sow rye early for either winter pasture or grain, as this crop is much less susceptible to infestation. *Harmolita tritici*, Fitch, was about as abundant as in 1939 [*cf. loc. cit.*] with an average infestation of 8·7 per cent. Other pests were of little importance.

HOUSER (J. S.). **The Black Wheat-stem Sawfly.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **25** no. 206 p. 151, 1 fig. Wooster, Ohio, 1940.

Infestations of wheat by *Trachelus tabidus*, F., in Ohio continued to decline in areas already infested and spread little in 1940 [*cf. R.A.E.*, A **28** 223]. Where significant infestations were recorded, farmers are advised to continue to harvest the wheat just before it is completely ripe [*cf.* **24** 297].

BRENTZEL (W. E.) & MUNRO (J. A.). **Bacterial Ring Rot of the Potato. Investigation on possible Dissemination by Grasshoppers.**—*Bull. N. Dak. agric. Exp. Sta.* no. 295, 8 pp., 2 figs., 3 refs. Fargo, N. Dak., 1940.

Bacterial ring rot of potato, a highly destructive disease caused by *Phytomonas sepedonica*, was first observed in North Dakota in April 1939, but subsequently spread with very great rapidity over a wide area. This suggested the possibility of its dissemination by grasshoppers, which have been abundant in the northern prairie States during the past few years and which, under favourable conditions, can migrate for several hundred miles in a few weeks [*cf. R.A.E.*, A **27** 33], feeding at intervals on their way. In greenhouse and field experiments, however, carried out with four species of *Melanoplus* grasshoppers allowed to devour considerable portions of infected potato plants and immediately transferred to healthy ones failed to transmit the disease, though bacteria similar to *P. sepedonica* were recovered from the alimentary tracts of almost all those examined.

TAYLOR (J. S.). **The Karroo Caterpillar.**—*Fmg in S. Afr.* 1940 repr. no. 79, 2 pp., 2 figs. Pretoria, 1940.

The larvae of *Loxostege frustralis*, Zell., which occurs over a large area in South Africa every year, but only occasionally reaches outbreak proportions, have been particularly destructive in the north-east of the Karroo since 1937, and have caused increasing concern to sheep farmers. The principal food-plant in this area is karroo-bush (*Pentzia incana*); the larvae also feed on a number of other veldt plants, a list of which is given, but statements that they attack tomato, beet, some garden flowers and lucerne have not been confirmed by either laboratory or field observations. In the laboratory, only one of a number of newly hatched larvae placed on lucerne leaves matured. The larvae usually appear in numbers after rain or damp and sultry weather; in the summer of 1938–39, a heavy infestation occurred in November, and many adults emerged after a few weeks, but there was no further infestation until considerably later in the season when rain had fallen. In 1939–40, on the other hand, when the first flight of adults took place on 11th October, the larvae were abundant between 24th October and 9th November, and again in December, towards the end of January and a month later, each infestation following rain or damp weather. Since the second infestation was often at a considerable distance from the first, it is possible that the adults migrate. After an infestation, the karroo-bush appears to be dead, and the stock are said to refuse to feed on it, but ultimately the plants recover.

The eggs are deposited singly or in small clusters on the lower surface of the leaves of the food-plant, and hatch after 5–11 days, depending on the temperature. The larvae spin webbing over the plants when young, but cease to do so when nearing maturity. After feeding for 20–24 days in October–November or 15–17 days in December, they enter the soil and form cocoons, but may remain in diapause for many months before pupating. In summer, the adults frequently emerge after 8–17 days, but more than 50 per cent. of a collection of 120 larvae that entered the soil in November 1939 were alive but had not pupated in August 1940. The adults occur practically throughout the year, but are numerous only during favourable weather in summer.

They are active and oviposit in the daytime as well as at night, when both sexes are attracted in large numbers by lights. In captivity, the moths lived up to 29 days, and oviposition continued for 10–12 days, beginning some days after emergence and finishing several days before death. The average duration of adult life appeared to be about 15 days.

The larvae are parasitised by the Tachinid, *Sturmia partitor*, Curr., and a Braconid of the genus *Macrocentrus*. The egg of *S. partitor* is usually deposited near the head of the host, and the larva emerges after the host has entered the soil and pupates within its cocoon. *Macrocentrus* is itself attacked by a Chalcidoid hyperparasite. Some farmers claim to have controlled *L. frustralis* by means of simple light-traps or fires, but these methods, even if successful, are not likely to be practicable except on a comparatively small scale, and should not be used in a considerable section of the Karroo on account of the danger to *Cactoblastis* [*cactorum*, Berg].

JOTISALIKARA (L.). **Annual Report of the Cotton Experiment Station, Klongtan, Swankaloke, (Thailand) B.E. 2480 (1937–38).**—41 pp. Bangkok, Dep. Agric. Fish. Thailand, August, B.E. 2480 [1938].

Sections of this report (pp. 3–6, 12) deal with observations on cotton pests in Thailand in the year ending March 1938, when they were more prevalent than in the preceding year [*cf. R.A.E.*, A **27** 49]. A weevil of the genus *Amorphoidea* infested the flowers and apparently caused extensive shedding of the young bolls, and *Platyedra gossypiella*, Saund., destroyed a large proportion of the bolls of all stages. *Sylepta derogata*, F., and *Pempherulus* (*Pempheres*) *affinis*, Faust, occurred in small numbers, the latter attacking cotton that was planted early. The maximum, minimum and average periods required for the development of the various stages of *Platyedra gossypiella* and *S. derogata* and the numbers of eggs laid by females of the latter are shown in tables. American varieties were in general freer from insect attack than Cambodian varieties, but Jassids were troublesome on them.

KOIDZUMI (K.) & SHIBATA (K.). **Studies on *Eriogyna pyretorum* Westw. and its Fishing Thread. XI. Epiparasites.** [*In Japanese.*] —*J. Soc. trop. Agric. Formosa* **12** no. 4 pp. 259–265. Taihoku, 1940.

The silk of *Eriogyna* (*Saturnia*) *pyretorum*, Westw., is used in Formosa for making fishing lines. The eggs of this moth are laid on the twigs of *Liquidambar formosana* [*cf. R.A.E.*, A **25** 381] in masses averaging about 110, and over 95 per cent. of them hatch in the field. They are parasitised, however, by *Anastatus albitarsis*, Ashm., and *Ooencyrtus* (*Schedius*) *kuvanae*, How., which destroy about 15 per cent. of the eggs in 30–40 per cent. of the egg-masses. *Anastatus* is commoner than *Ooencyrtus* and accounts for over 90 per cent. of the total parasitism. The numbers of eggs deposited in a single host egg by the two parasites average 1 and 1·43, respectively; the adults emerge mostly in March, but emergence continues until May.

MISAKA (K.), KOREISHI (T.) & KAYASHIMA (I.). **Observations concerning the Injuries of Fruit Flies to Fruits and Vegetables in Formosa. Injuries to Tomato.** [*In Japanese.*]—*Res. Bull. Pl. Quar. Sta. Formosa* no. 7, 59 pp., 3 pls. Taihoku, Bur. Ind. Govt. Formosa, Publ. no. 893, 1940.

In Formosa, *Prodenia litura*, F., *Agrotis ypsilon*, Hfn., and *Anophia* (*Catephia*) *leucomelas*, L., feed on the fruits of tomato, and the Anthomyiids, *Atherigona exigua*, Stein, and *A.* (*Acritochaeta*) *crassiseta*, Stein, infest decayed parts of the fruits. Trypetids do not attack tomatos in the field, but sometimes oviposit in the ripe fruits when enclosed with them in paper bags. Oviposition also occurs on completely ripe fruits in the laboratory, but not on unripe or moderately ripe ones.

MISAKA (K.), KOREISHI (T.) & SATO (A.). **Observations concerning the Injuries of Fruit Flies to Fruits and Vegetables in Formosa. Injuries to Mango.** [*In Japanese.*]—*Res. Bull. Pl. Quar. Sta. Formosa* no. 8, 31 pp., 2 pls. Taihoku, Bur. Ind. Govt. Formosa, Publ. no. 896, 1940.

Of 9,043 mango fruits collected in the field in Formosa, 1,250 had been attacked by *Dacus* (*Chaetodacus*) *ferrugineus dorsalis*, Hend.; 35·9 per cent. of the completely ripe fruits were attacked, but none of the unripe ones. In some varieties only damaged fruits were infested. Covering the fruits with paper bags prevents the females from ovipositing in them.

SHIBATA (K.). **Ecology of subterranean Insects. III. Effect of Exsiccation on the Vitality of Pupae of** *Chaetodacus cucurbitae* **Coq. and** *C. ferrugineus dorsalis* **Hend.** [*In Japanese.*]—*J. Soc. trop. Agric. Formosa* **13** no. 1 pp. 54–62. Taihoku, 1941.

In the experiments described, pupae of the Formosan fruit-flies, *Dacus* (*Chaetodacus*) *cucurbitae*, Coq., and *D.* (*C.*) *ferrugineus dorsalis*, Hend., were kept at 25°C. [77°F.] in soil containing 4 per cent. water [*cf. R.A.E.* A **21** 149], under which conditions they completed the pupal stage in 8–9 and 10–11 days, respectively. Some of the pupae were exposed at various intervals to desiccation. The percentage losses of body moisture that caused complete mortality of pupae within a day of the beginning and end of the pupal stage were 20 and 28, respectively, for *D. cucurbitae*, and 25 and 29 for *D. f. dorsalis*. When less than 24 hours old, pupae of *D. cucurbitae* died in 45 minutes at 45 per cent. relative humidity, in an hour at 60 per cent., and in 6 or 7 hours at 80 or 90 per cent.

MORIYAMA (T.). **Insects injurious to Coffee Berries.** [*In Japanese.*]—*Formosan agric. Rev.* **37** no. 1 pp. 14–20, 3 figs. Taihoku, 1941.

Pseudococcus citri, Risso, infests the berries of coffee in Formosa and is commoner in shaded sites. Mature berries are little injured, but the unripe ones become deformed or drop to the ground. The Lymantriid, *Porthesia taiwana*, Shir., also feeds on the berries, causing deformation and decay, especially in the young fruits.

SONAN (J.). **Two Kinds of Ants collecting Plant Seeds.** [*In Japanese.*] —*Formosan agric. Rev.* **37** no. 6 pp. 473–476. Taihoku, 1941.

In Formosa, the ants, *Pheidole javana*, Mayr, and *Pheidologeton diversus*, Jerd., carry away the seeds of vegetables soon after they are sown, and sometimes cause serious loss. The former also collects the seeds of *Cinchona*, and the latter occasionally feeds on the stalks of cabbage and egg-plant [*Solanum melongena*]. Seeds can be protected by dipping them in petroleum oil and then covering them with ash immediately before sowing, while manuring the plots with human excreta repels the ants. Digging trenches round gardens is also recommended.

NAKAYAMA (S.). **On the Number of Eggs laid by *Calandra oryzae* L. at constant Temperature.** [*In Japanese.*]—*Rep. Ass. Adv. Sci. Japan* **16** no. 1 pp. 117–119, 1 fig. Tokyo, 1941.

In experiments at Suigen, Korea, the number of eggs laid by females of *Calandra oryzae*, L., kept at 26–27°C. [78–80·6°F.] and 80–85 per cent. relative humidity from mid-October to late December averaged 68·75; 56 per cent. of the females deposited 50–90 eggs, and 10 per cent. over 100.

YAMAMURO (R.) & HOSHINO (K.). **Observations on *Lygus viridis* Fall.** [*In Japanese.*]—*Rep. Dep. Seric. agric. Exp. Sta. Korea* **4** no. 2 pp. 37–57, 4 pls. Suigen, 1940.

Lygus viridis, Fall., all stages of which are described, attacks mulberry in Korea, causing serious damage in some regions. This Capsid has one generation a year; near Suigen, the adults occur from late May to late July, apparently living for about 6–7 weeks, as they emerge in late May or early June. They concentrate in shady places and fly during the day, feeding on the young growth of the mulberry trees at night. They also attack the fruits, even after they have dropped to the ground, but have not been observed on other plants. Oviposition begins about 25 days after emergence and continues for about 17 days. The females lay 36–64 eggs singly or in pairs in the crevices of the buds at night. The eggs overwinter and hatch in late April and May. The bugs are destroyed by Coccinellids and spiders, while spraying with lime-sulphur in spring kills the eggs.

OKADA (I.). **Oviposition Habits of *Grapholitha glycinivorella* Mats., especially in Relation to Varieties of Soy Bean. (Preliminary Report.)** [*In Japanese.*]—*Res. Bull. Kung-Chu-Ling agric. Exp. Sta.* no. 32 pp. 93–105, 3 figs. Kung-Chu-Ling, 1940.

The adults of *Cydia* (*Grapholitha*) *glycinivorella*, Mats., which infests soy beans, are present in Manchuria from late July to early September. The females oviposited in the afternoon, beginning a day after pairing, and survived for 7–20 days. The average number of eggs laid during life was 164·7, but up to 100 were laid in a single day, usually only one per pod. If only young pods were available, the moths oviposited on other parts of the plant; they visit other cultivated leguminous plants, but apparently do not lay eggs on them. More eggs were deposited on large pods and only a few on small ones. Oviposition hardly ever occurred on mature hard pods, and was rare on hairless ones in the laboratory, though hairless pods are infested in the field.

Uchida (T.) & Okada (I.). **Importance of Control of** *Grapholitha glycinivorella* **Mats. in Manchuria and Problems of its Studies.** [*In Japanese.*]—*Res. Bull. Kung-Chu-Ling agric. Exp. Sta.* no. 32 pp. 107–134, 1 pl. Kung-Chu-Ling, 1940.

Descriptions are given of all stages and the life-history of *Cydia* (*Grapholitha*) *glycinivorella*, Mats., on soy bean in Manchuria. The damage it causes is severe enough to make its control an important problem ; subjects for future investigation are discussed.

Okada (I.) & Oike (K.). **Biological Observations on** *Pristomerus chinensis* **Ashm., a Parasite of** *Grapholitha glycinivorella* **Mats.** [*In Japanese.*]—*Trans. biol. Soc. Manchuria* **3** no. 3 pp. 87–90, 1 fig. Hsinking, 1940.

Cydia (*Grapholitha*) *glycinivorella*, Mats., which is an important pest of soy beans in Manchuria, is parasitised by *Pristomerus chinensis*, Ashm. Near Koshurei, this Ichneumonid has one generation a year. The adults are common in late July and early August, but do not occur after early September. Males and females lived for average periods of 17·8 and 31·5 days, respectively. The female oviposits in the young larvae of *Cydia* before they enter the bean pods. The larvae overwinter in their hosts, and leave them to pupate in late July and early August. The prepupal and pupal stages last about two and seven days. No alternative hosts are known.

Saito (S.). **Preliminary Notes on a new injurious Insect of the Rice Plant,** *Homorocoryphus jezoensis* **Mats. et Shir.** [*In Japanese.*]—*Agric. & Hort.* **15** pp. 1154–1156, 2 figs. Tokyo, 1940. (With a Summary in English.)

A description is given of the adults of the Tettigoniid, *Homorocoryphus jezoensis*, Mats. & Shir., which occurs in large numbers in rice-fields in Aomori Prefecture, causing much damage. It has one generation a year and overwinters in the egg stage. The eggs hatch in the second half of June and early July, and the adults appear in August. Pairing continues until mid-September, and oviposition from mid-September to October. The females lay about 50 eggs, which are inserted into the leaf-sheaths of grasses above or below the ground. The adults are active, especially at night, but the young nymphs are sluggish and occur on the lower surface of the rice leaves or among the bases of grasses. The nymphs consume the whole leaf, excepting the ribs, and also attack the stalks of shoots and both ripe and unripe seeds ; the ears turn whitish and show symptoms typical of borer injury. The wild grasses attacked include *Phalaris arundinacea*.

Yashiro (H.) **General Notes on important Insect Pests in Loochoo.** [*In Japanese.*]—*Agric. & Hort.* **15** pp. 2426–2432. Tokyo, 1940.

Brief notes are given on some of the more important pests of crops in the Loochoo Islands, including *Cylas formicarius*, F., *Chaetocnema* (*Haltica*) *tibialis*, Ill., *Colasposoma oberthüri*, Jac., *Anophia* (*Catephia*) *leucomelas*, L., *Brachmia macroscopa*, Meyr., and *Metriona circumdata*, Hbst., on sweet potato, *Sesamia inferens*, Wlk., *Eucosma schistaceana*, Sn., *Scirpophaga nivella*, F., *Anomala* (*Euchlora*) *xanthopleura*, Arr., and *Oregma* (*Ceratovacuna*) *lanigera*, Zehnt., on sugar-cane, and

Schoenobius bipunctifer, Wlk. (*incertellus*, Wlk.), *Cnaphalocrocis medinalis*, Gn., *Lagynotomus assimulans*, Dist., and *Scotinophara lurida*, Burm., on rice.

TAMURA (I.). **Control Experiments with *Penthaleus haematopus* Koch, which occurred in Ibaragi Prefecture.** [*In Japanese.*]—*Agric. & Hort.* **15** pp. 2280–2286, 5 figs. Tokyo, 1940.

Penthaleus major, Dug. (*haematopus*, Koch) caused severe injury to wheat in Ibaragi Prefecture, near Tokyo, during a dry period early in 1940. The infested fields had a southern exposure, and the soil was light and well aerated. The injury began in late March and was most severe in April, when the leaves turned yellow and withered, but was slight in May and June. There were usually as many as 20–30 mites on a leaf, and they attacked the lower surface, remaining in sheltered places on fine days. In experiments, all the mites were killed by sprays of soap solution containing pyrethrum, derris, nicotine sulphate or fish oil.

ESAKI (T.) & MOCHIZUKI (M.). **Report on the Leaf-hoppers injurious to the Rice Plant and their Natural Enemies, no. 12 (for the Year 1940).** [*In Japanese.*]—33 pp., 1 fig. Fukuoka, Dep. Agric., Kyushu Imp. Univ., 1941.

The numbers of Delphacids and Jassids taken at a light-trap at Oita, Kyushu, from May to September 1940 are shown in graphs; the former were more abundant on rice than usual [*cf. R.A.E.*, A **29** 101] and caused serious damage in some districts from late August onwards. The commonest species were *Nilaparvata oryzae*, Mats., and *Sogata furcifera*, Horv., while *Delphacodes striatellus*, Fall., was more numerous than in the preceding year. *S. furcifera* increased in August, and *N. oryzae* did so rapidly in mid- and late September. *Nephotettix bipunctatus cincticeps*, Uhl., was abundant in late June, late July and particularly mid-September. In experiments, this Jassid oviposited in *Echinochloa crusgalli edulis*, *Alopecurus aequalis* and *Poa annua*, but not in *Astragalus* or *Phragmites*; some eggs were laid in wheat in the laboratory and in the field. The overwintered eggs of *Deltocephalus dorsalis*, Motsch., hatched in mid-May, and the nymphal stage lasted 26–30 days. Many adults and nymphs of *Sogata furcifera* and *Nilaparvata oryzae* collected in the field from early November to late December were kept on rice, *Poa annua* and *Astragalus*, but all were dead by mid-January.

Notes are given on the natural enemies of the Delphacids. Dryinids parasitised 7·69 per cent. of *Delphacodes striatellus*; they included *Haplogonatopus atratus*, Esaki & Hash., the adults of which emerged about 15 days after the cocoons were spun, and *H. japonicus*, Esaki & Hash., the egg of which is described.

KUWAZUKA (K.), OGUSA (K.) & ANDO (N.). **Experiments on Controlling the Rice Borer with Insecticides. 1. Field Experiments with various Kinds and Dosages of Insecticides.** [*In Japanese.*]—*Extra Rep. Aichi agric. Exp. Sta. 1940*, 88 pp., 4 pls. Nagoya, 1940.

Experiments in Japan on the value of various insecticides against the adults of *Chilo simplex*, Btlr., in rice-fields showed that the greatest

mortality was given by dusting with nicotine, which also seemed to prevent oviposition. A spray of nicotine sulphate (1 : 800 or 1 : 1,000) and soap was not very effective and injured the plants, and dusting with a mixture of pyrethrum and ash gave poor results.

KUWANA (Z.), ISHII (G.) & KUROSAWA (T.). **On the Parasitic Wasps of *Margaronia pyloalis* Walk.** [*In Japanese.*]—*Jap. J. Seric.* **11** no. 4 pp. 243–256, 1 fig. Tokyo, 1940.

The parasites of *Margaronia pyloalis*, Wlk., on mulberry in Japan include *Pimpla* (*Exeristes*) *roborator*, F., *P.* (*Epiurus*) *persimilis*, Ashm., *Ephialtes nakamurai*, Uch., *Spilocryptus japonicus*, Uch., *Apanteles minor*, Ashm., *A. kurosawai*, Watan., *Macrocentrus philippinensis*, Ashm., *Perisierola* sp. and *Eurytoma* sp. [*cf. R.A.E.*, A **28** 263 ; **29** 34, 101]. Brief descriptions of these nine species are given, together with notes on their bionomics.

KUWANA (Z.), ISHII (G.) & KUROSAWA (T.). **Studies on the Hymenopterous Parasites of *Margaronia pyloalis* Walk. (Lepidoptera), II. *Macrocentrus philippinensis* Ashm. (Braconidae).** [*In Japanese.*] —*Rep. seric. Exp. Sta. Tokyo* **10** no. 1 pp. 1–26, 2 pls., 8 figs. Tokyo, 1940. (With a Summary in English.)

In this second paper [*cf. R.A.E.*, A **29** 101], descriptions are given of all stages of *Macrocentrus philippinensis*, Ashm., which parasitises the larvae of *Margaronia pyloalis*, Wlk., on mulberry in Japan. The adults lived for 2–5 weeks when fed on sugar solution. Females were more numerous than males and oviposited in host larvae of all instars, but very young larvae were killed by the ovipositors and the eggs did not survive in them. The number of eggs laid daily was 13–69 ; usually only one was deposited in a single host, and if there were more, only one hatched. Oviposition by the overwintered generation began in late May, and the eggs hatched in 5 or 6 days. The larvae pass through 4 instars and those of the first generation completed their development in 6–15 days. They fed ectoparasitically for 8–10 hours after the third moult and pupated in cocoons, the pupal stage lasting 3–10 days. There are usually 5 generations a year, the winter being passed in the prepupal stage in the cocoon. The percentage parasitism varied from 6·8 to 69·2.

TAMURA (I.). **Studies on the Feeding-marks caused by Insects.** [*In Japanese.*]—*Bot. & Zool.* **9** pp. 134–140, 22 figs. Tokyo, 1941.

Briefly annotated illustrations are given of various types of lesions made by insects while feeding on agricultural plants in Japan.

TORII (S.), YAMADA (Y.) & MIYAJIMA (S.). **Measures for the Protection of Cloth Book Covers against Insect Pests and Rats.** [*In Japanese.*] —*Bochu Kagaku* no. 4 pp. 1–3. Kyoto, 1940.

Observations are recorded showing that cloth book covers soaked in a solution of rotenone are not attacked by insects and rats.

YAMADA (Y.). **On** *Blatta concinna* **de Haan, a Pest of Book Covers.** [*In Japanese.*]—*Bochu Kagaku* no. 4 pp. 4–7. Kyoto, 1940.

Blatta concinna, de Haan, feeds on cloth book covers in Japan. The adults are commonest from May to November ; eggs are present from June to August and hatch in about 40 days.

YAMADA (Y.). **On** *Tinea pellionella* **L.** [*In Japanese.*]—*Bochu Kagaku* no. 4 pp. 14–20, 3 pls. Kyoto, 1940.

Brief descriptions are given of all stages of the clothes moth, *Tinea pellionella*, L. It has one generation a year near Kyoto, and overwinters in the larval stage. The adults appear continuously from late May to early October and are active in dark places. Females laid 23 eggs in 3 days and 42 in a week, depositing them singly on muslin, woollen materials and animal skins. The eggs hatched in a week. The larvae are active in darkness and injure dirty clothes more than clean ones. The construction of the larval cases is described. The pupal stage lasted 14–19 days.

YAMADA (Y.). **Relation of Injuries of Insect Pests of woollen Material to Temperature.** [*In Japanese.*]—*Bochu Kagaku* no. 4 pp. 21–30. Kyoto, 1940.

It was observed that partly grown larvae of *Tineola biselliella*, Humm., which attack woollen materials, do not feed at temperatures below 5°C. [41°F.], but are active at higher temperatures even in winter. Partly grown larvae of *Anthrenus verbasci*, L., also ceased to feed at 5°C. or below.

YAMADA (Y.). **Oviposition and Hatching of** *Anthrenus verbasci* **L. at constant 12°C.** [*In Japanese.*]—*Bochu Kagaku* no. 4 pp. 31–34. Kyoto, 1940.

At a constant temperature of 12°C. [53·6°F.], the adults of *Anthrenus verbasci*, L., were able to pair and oviposit, but some of the eggs failed to hatch and only about 50 per cent. of the larvae gave rise to adults. The pupal stage averaged 48 days, and the adults remained in the pupal cases for 20–35 days after emergence. Females deposited 11–50 eggs 5–29 days after pairing.

YAMADA (Y.) & TANIGUCHI (H.). **Numbers of the Adults of** *Anthrenus verbasci* **L. attracted to the Flowers of** *Chrysanthemum leucanthemum* **and collecting them.** [*In Japanese.*]—*Bochu Kagaku* no. 4 pp. 35–45, 4 figs. Kyoto, 1940.

Near Kyoto, the adults of *Anthrenus verbasci*, L., visit the flowers of ox-eye daisy (*Chrysanthemum leucanthemum*) from mid-May to late June, and are most common on them in late May and early June and from 9 a.m. to 2 p.m. The females are more numerous than the males, but little control is afforded by collecting them, since most of them appear to have laid all their eggs.

HORIUCHI (R.). **Observations on *Gypsonoma minutana* Hübner (Eucosmidae).** [*In Japanese.*]—*Nojikairyoshiryo Minist. Agric. Japan* no. 152 pp. 86–88. Tokyo, 1940.

The larvae of *Enarmonia* (*Gypsonoma*) *minutana*, Hb., all stages of which are described, feed on the leaves of willows and poplars near Yokohama. This Tortricid has three generations a year, the adults emerging in late May, early July and late August, and the winter is passed in the larval stage. Females lay about 50 eggs singly on both surfaces of the leaves at the basal part of mid-rib. The egg, larval and pupal stages last about 7–13, 15–20 and 7–13 days, respectively.

SUZUKI (I.). **Insect Pests of Seeds exported from Japan.** [*In Japanese.*] —*Nojikairyoshiryo Minist. Agric. Japan* no. 152 pp. 107–108. Tokyo, 1940.

Bruchus ademptus, Sharp, infests up to 6 per cent. of the seeds of kudzu (*Pueraria hirsuta*) in Japan. It apparently has several generations a year, and the overwintered larvae give rise to adults from late April. All stages of this Bruchid are described.

HARADA (T.). **On *Pachymerus gonager* Fab.** [*In Japanese.*]—*Nojikairyoshiryo Minist. Agric. Japan* no. 152 pp. 108–110, 2 figs. Tokyo, 1940.

Seeds of *Cassia fistula* imported from Hawaii into Japan were found on arrival to be infested by *Pachymerus gonager*, F., all stages of which are described. This Bruchid was bred in the laboratory and apparently has two generations a year, overwintering in the larval stage. The adults emerged in July and October and oviposited on various leguminous plants, but not on peas.

IWASA (T.) & SHIBUYA (T.). **Experiments on the Possibility of the Breeding of *Cylas formicarius* in Japan under natural Temperature.** [*In Japanese.*]—*Nojikairyoshiryo Minist. Agric. Japan* no. 152 pp. 116–118. Tokyo, 1940.

In further experiments at Kobe to determine whether *Cylas formicarius*, F., can survive under natural conditions in Japan [*cf. R.A.E.*, A **27** 616], two generations were reared between early June and October. The adults lived for 70–80 days at this season, but did not survive so long later in the year. The larvae overwintered in sweet-potato tubers. The insects were unable to survive in decayed tubers.

SHIMIZU (T.). **Beetles boring into Timbers in Japan.** [*In Japanese.*]— *Nojikairyoshiryo Minist. Agric. Japan* no. 152 pp. 133–146. Tokyo, 1940.

Lists are given from the literature of Longicorns, Scolytids, Buprestids and other Coleoptera recorded as boring in trees in Japan, arranged under the trees attacked.

SAITO (K.). **A Contribution to Dendro-entomology.** [*In Japanese.*]—*Bull. Agric. For. Coll. Korea* no. 6; 272 pp., 67 figs. Suigen, 1941. (With a Summary in German.)

This is a detailed account, based on the literature and original observations [*cf. R.A.E.*, A **23** 263], of the effects of injurious insects upon the shape of trees.

INOUYE (M.). **On the Control of *Adelges japonicus* Monzen.** [*In Japanese.*]—*Circ. Hokkaido For. Exp. Sta.* no. 24, 68 pp., 4 figs. Nopporo, 1940.

Descriptions are given of all stages of *Chermes* (*Adelges*) *japonicus*, Monzen, which is very injurious to spruces (*Picea* spp.) in Hokkaido, together with an account of its bionomics [*cf. R.A.E.*, A **26** 437]. Vigorous and fast-growing trees are less attacked. Effective control of the overwintered nymphs is given by spraying in spring with emulsions of petroleum oil, with or without pyrethrum, or of fish oil, or with a resin wash. The spring eggs are less resistant to insecticides than the autumn ones.

INOUYE (M.). **On Insect Pests in Forests of *Fraxinus mandschurica* and Methods of controlling them.** [*In Japanese.*]—*Circ. Hokkaido For. Exp. Sta.* no. 25, 26 pp., 23 figs. Nopporo, 1940.

Stereonychus thoracicus, Faust, attacks Manchurian ash (*Fraxinus mandschurica*) in forests in Hokkaido. The larvae feed only on the lower surfaces of the leaves, but the adult weevils also attack the basal parts of the leaf stalks and the new buds. The adults appear in July and again in early October and live for two or three weeks in captivity. Larvae are present in late June and late August, and pupate in cocoons in the soil or among fallen leaves near the trees; 67 per cent. of the pupae are parasitised by *Microcryptus sapporensis*, Uch., and a fungus. The weevils drop to the ground when disturbed and they can then be collected and destroyed; spraying with calcium or lead arsenate is recommended against the larvae.

The Aphid, *Prociphilus oriens*, Mordv., causes injury to the ash trees in spring. The infested leaves curl in May and June, and the growth of the shoots is retarded. The eggs hatch from mid-April, and alatae develop in the following generation and migrate to the roots of *Abies* [*cf. R.A.E.*, A **27** 211; **29** 173], where an apterous generation is completed; the sexuparae return to ash in the autumn. The control measures recommended are collecting infested leaves and spraying against the young Aphids in spring. Larvae of the Pyralid, *Margaronia* (*Glyphodes*) *nigropunctalis*, Brem., sometimes defoliate *F. mandschurica* and also feed on the leaves of *Firmiana* and lilac (*Syringa*). There are two generations a year, the adults emerging in June and September–October. Collecting the larvae and spraying with lead arsenate are effective for control. All stages of these three pests are described.

ISHII (T.). **The Species of *Trichogramma* in Japan, with Descriptions of two new Species.**—*Kontyû* **14** pp. 169–176. Tokyo, 1941.

The new species described are *Trichogramma chilonis*, from the eggs of *Chilo simplex*, Btlr., *Diatraea* sp. and *Eucosma schistaceana*, Sn.,

in the Philippines, Formosa and Japan, and *T. jezoensis*, from those of *Cydia* (*Grapholitha*) *glycinivorella*, Mats., in Hokkaido.

HARUKAWA (C.) & NISIKAWA (Y.). **The Resistance of the Adult of *Phyllotreta vittata* to low Temperatures in Winter.** [*In Japanese.*] —*Kontyû* **14** pp. 200–207, 3 figs. Tokyo, 1941.

Adults of *Phyllotreta vittata*, F., which is injurious to vegetables in Japan and overwinters in the adult stage, were collected in the field from January to March near Kyoto and exposed to low temperatures. All beetles exposed for up to 15 days to −5°C. [23°F.] survived, but about 10 per cent. died when the exposure was increased to about 20 days. About 20–30 per cent. were killed by exposure to −10°C. [14°F.] for 5 days, while at −16°C. [3·2°F.] in March, 50 per cent. were killed after about 12 minutes and 95 per cent. after 10 hours. In late February, 50 per cent. were killed at −18°C. [−0·4°F.] in 97 minutes.

KAMIYA (K.). **The natural Enemies of *Adoxophyes privatana* Walk.** [*In Japanese.*]—*Kontyû* **14** pp. 224–226. Tokyo, 1941.

The Tortricid, *Adoxophyes privatana*, Wlk., is injurious to tea plants in Japan [*cf. R.A.E.*, A **24** 669]. The eggs are parasitised by *Trichogramma dendrolimi*, Mats. ; the larvae by *Omorgus* sp. and four Braconids, including *Apanteles* sp., *Ascogaster* sp. and *Meteorus* sp. ; and the pupae by *Brachymeria obscurata*, Wlk., *Pleurotropis* sp., *Pimpla* (*Nesopimpla*) *naranyae*, Ashm., and *P.* (*Exeristesoides*) *spectabilis*, Mats. The Carabids, *Chlaenius naeviger*, Moraw., and *Parena nigrolineata*, Chaud. (*Crossoglossa latecincta*, Bates), are predacious on both larvae and pupae.

IYATOMI (K.). **On the Effect of Temperature and Humidity upon the Emergence of *Trichogramma japonicum* Ashm.** [*In Japanese.*]— *Kontyû* **14** pp. 233–236. Tokyo, 1941.

The eggs of *Ephestia cautella*, Wlk., which are used for mass breeding of *Trichogramma japonicum*, Ashm., in Japan, are more resistant to low humidity than those of *Chilo simplex*, Btlr., the natural host, while *T. japonicum* is more resistant to it in the eggs of *Ephestia* than in those of *Chilo*. The limits of temperature and humidity are a little more restricted in the parasite than in the hosts.

KOO (M.). **Studies on *Pyrausta nubilalis* Hübner attacking the Cotton Plant.** [*In Japanese.*]—82 pp., 3 pls., 26 figs. Kofu, Yamanashi agric. Exp. Sta., 1940.

In Yamanashi Prefecture, Honshu, cotton is attacked by *Pyrausta nubilalis*, Hb., which has three overlapping generations a year, the adults emerging from late May to early October. The overwintered larvae pupate from mid-May to late June, mostly in late May. The females are somewhat more numerous than the males and represented 65·7 per cent. of the adults taken in a light-trap ; the largest catches were made in late August and early September. Females lived for up to 17·6 days and males for up to 8. Oviposition began 2–4 days after emergence and continued for 2–10 days, most eggs being laid on the first day. The average and maximum numbers of eggs laid per

female were 134·7 and 564, a single mass containing 26–32 eggs; 88·9 per cent. of the eggs were found on the lower surfaces of cotton leaves. Oviposition occurs on cotton from late June to early October, mostly from late August onwards. Injury to cotton is conspicuous from late July to mid-October and is serious in September. The larvae hatched in 3–5 days and bored into the plants about 6 days later; the larval stage averaged 31·4 days in spring and 19·3 days in summer, and the pupal stage lasted 6–19 days. The larvae entered hibernation from early September to late October, but only 10 per cent. of the overwintering population reached the adult stage, owing to heavy mortality from early March onwards. About 88 per cent. of the hibernating larvae were found among fallen leaves and in cotton stalks. This Pyralid attacks several other plants in Yamanashi Prefecture, where hemp and *Sorghum* received more eggs and suffered greater injury than maize. Over 96 per cent. of the eggs are sometimes parasitised by *Trichogramma* spp. The Tachinid, *Ceromasia senilis*, Mg., parasitises the larvae, while the predacious Anthocorid, *Orius* (*Triphleps*) *sauteri*, Popp., destroys the eggs and the young larvae before they enter the plants, and the Carabid, *Chlaenius pictus*, Chaud., also feeds on the larvae. Sprays of Bordeaux mixture or a proprietary derris preparation did not prevent oviposition, and although dusting with tobacco decreased it and the subsequent injury, it increased the dropping of the buds and bolls. Spraying with lead arsenate decreased injury, and calcium arsenate also gave promising results.

YASHIRO (H.). **Notes of *Anophia leucomelas* L., a Pest of Sweet Potato.** [*In Japanese.*]—*Ōyō Kontyū* **2** no. 6 pp. 231–239. Tokyo, 1940.

Anophia leucomelas, L., which is a pest of sweet potato in the Loochoo Islands, is widely distributed in Japan, but does not occur north of Akita Prefecture, Honshu. Very good control of the young larvae is given by a spray of lead arsenate, but the older ones are more resistant.

KAWADA (A.) & SUENAGA (H.). **On the Chestnut Bark Miner, *Acrocercops* sp., 2.** [*In Japanese.*]—*Ōyō Kontyū* **2** no. 6 pp. 240–255, 4 figs. Tokyo, 1940.

Descriptions are given of all stages of the species of *Acrocercops* that attacks chestnut in Japan [*cf. R.A.E.*, A **26** 669; **29** 99]. The larvae mine under the bark of new branches and seem to be sap-feeders in the first three instars. Pupation occurs under the bark, and an emergence hole for the adult is sometimes constructed by the larva. The adults emerge in the evening and pair at night. The eggs are usually laid singly on the growing parts of the branches. The larvae are parasitised by a Braconid and an Ichneumonid, the pupae by a Pteromalid of the genus *Pachyneuron*, and both stages by a fungus. Spraying with lead arsenate, calcium arsenate, nicotine sulphate or pyrethrum and soap is recommended for control.

KOYAMA (T.). **On the Hibernation of *Paraluperodes suturalis nigrobilineatus* Motsch.** [*In Japanese.*]—*Ōyō Kontyū* **2** no. 6 pp. 256–259. Tokyo, 1940.

Soy beans in Japan are attacked by *Monolepta* (*Paraluperodes*) *nigrobilineata*, Motsch. Hibernating adults of this Galerucid were found in large numbers among fallen leaves and in the soil to a depth of just over an inch.

YENDO (K.). **Outbreak of *Cirphis unipuncta* Haw. in Saghalien.** [*In Japanese.*]—*Ōyō Kontyū* **2** no. 6 pp. 260–261, 1 fig. Tokyo, 1940.

In the summer of 1939, larvae of *Cirphis unipuncta*, Haw., occurred in large numbers in southern Sakhalin. They fed on various grasses, but caused little damage to maize.

TAMANUKI (K.). **Injuries of *Picea* and *Abies* caused by Scolytids after Storm Damage.** [*In Japanese.*]—*Ōyō Kontyū* **2** no. 6 pp. 261–263, 2 figs. Tokyo, 1940.

A typhoon caused serious injury to spruce and fir (*Abies*) in south-eastern Sakhalin in October 1936. The trees were subsequently attacked by Scolytids and other beetles; about 50 per cent. were infested in 1937, and the infestation subsequently became more severe. The species causing the greatest injury were *Ips typographus* f. *japonicus*, Niij., on spruce and *Polygraphus proximus*, Bldf., on *Abies*. The former attacks spruce trunks of all diameters, has a high rate of reproduction and is responsible for 80 per cent. of the damage. It prefers the parts of forests that are open to the sun, and infestation begins in such places.

NAKAYAMA (S.) & OKAMOTO (T.). **List of injurious Insects of Fruit Trees in Korea.** [*In Japanese.*]—*Rep. Korea agric. Exp. Sta.* **12** no. 3 pp. 195–247. Suigen, 1940.

A list is given of 280 insects and 3 mites that are injurious to fruit trees in Korea, with very brief notes on their bionomics and control.

YOKOO (T.). **Morphology and Distribution of three Anthomyiid Flies injurious to Vegetables in Korea.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **12** no. 5–6 pp. 187–208, 7 figs. Tokyo, 1940.

Descriptions are given of all stages of *Hylemyia antiqua*, Mg., which is injurious to onion throughout Korea, *H. floralis*, Fall., which occurs there north of 39°N. lat. and attacks cruciferous vegetables, and *Pegomyia hyoscyami*, Panz., which is apparently widely distributed and attacks spinach, beet and *Chenopodium album*.

MORI (H.). **Lethal Effect of Contact Insecticides upon Insect Eggs. 1. Pyrethrin.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **12** no. 5–6 pp. 209–214. Tokyo, 1940.

When eggs of *Chilo simplex*, Btlr., deposited in June and July were immersed for 10 seconds in acetone extracts of pyrethrum, the percentage mortalities of young and old eggs given by 0·01, 0·005 and 0·0005 per cent. solutions were 97 and 99, 23 and 97, and 0 and 17, respectively. Embryonic development was not prevented, but the embryos were killed after the nervous system had developed. The lethal mechanism must be due to the effect upon the nervous system or to feeding on the egg shells at the commencement of hatching.

ISHIHARA (T.). *Rodolia concolor* **Lewis as a natural Enemy of** *Drosicha corpulenta* **Kuw.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **12** no. 5–6 pp. 215–217. Tokyo, 1940.

The Coccinellid, *Rodolia concolor*, Lewis, the adults of which emerge in early June, has been observed in Tokyo feeding on the Coccid, *Drosicha corpulenta*, Kuw.

IJIMA (K.). **Effect of high Temperatures upon the Ability of Reproduction of** *Eucosma schistaceana* **Snellen. 2. On the Mechanism of Sterility caused by high Temperatures.** [*In Japanese.*]—*Oyo Dobuts. Zasshi* **12** no. 5–6 pp. 161–186. Tokyo, 1940. **3. Effects of variable high Temperatures upon the Sterility of Adults during the developing Period.** [*In Japanese.*]—*Op. cit.* **13** no. 1 pp. 1–13. 1941.

Further investigations in Formosa, recorded in the first paper, on the sterility induced by exposure to high temperature (32°C. [89·6°F.]) in the sugar-cane borer, *Eucosma schistaceana*, Sn. [*cf. R.A.E.*, A **29** 172] showed that 31·47, 92·23 and 100 per cent. of males that had been exposed in the egg, larval and pupal stages, respectively, were sterile. The females were little affected, but a few exposed in the pupal stage were sterile. Some of the sterile males exposed in the larval stage recovered their reproductive power in 7–17 days, but none of those exposed in the pupal stage did so.

In the experiments described in the second paper, the pupae were kept at 32°C. for 8 hours during the day and at room temperature (27–30°C. [80·6–86°F.]) at night. The resulting adults were allowed to pair with normal ones, and the viability of the eggs laid by the females was observed. The results showed that females were not affected by the treatment. Normal females paired with males that had been treated for over 9 days laid eggs of which about half did not develop, while males treated for over 16 days were rendered entirely sterile. High temperatures are common in summer in Formosa, and the decrease in the population of the moth at this season is apparently due to sterility of the males caused by them.

OTANES (F. Q.). **Notes on the Oriental Migratory Locust** (*Locusta migratoria manilensis* **Meyen**) **with special Reference to its Solitary Phase and Breeding Place or Outbreak Area.**—*Philipp. J. Agric.* **11** no. 4 pp. 331–353, 4 pls. (3 col.), 1 fldg. map, 20 refs. Manila, 1940.

According to records dating from 1912, the peaks of the outbreaks of *Locusta migratoria manilensis*, Meyen, in the Philippine Islands occur on an average every 10–11 years [*cf. R.A.E.*, A **24** 810]; the outbreaks last several years, the interval between them being only 1–2 years. Examples of phase *solitaria* are widespread and frequently met with in cultivated fields during the rainy season (June to November), though they become scarce during the dry season (February to May). Occasionally they give rise to loose swarms of phase *transiens*, as before the outbreaks of 1919–28 and 1932–39, but the species is unable to reach phase *gregaria* in the densely populated and cultivated areas. There is some evidence, however, that the swarms of phase *gregaria* that have invaded the Philippines were formed in the grasslands of the Cotabato district of Mindanao, where soils are generally

sandy and the climate is characterised by prolonged dryness, and where swarms of phase *transiens* could not be destroyed, owing to scarcity of population and transport difficulties. No swarms have been seen in this area since April 1938, but locusts taken in May 1940 showed some characteristics of phase *transiens*. This may be a sign of an impending outbreak, and scouting for phase *transiens* should be carried out in Cotabato and other scarcely populated areas; in Cotabato ecological investigations should be undertaken on the factors affecting phase transformation. This district has recently been opened up for colonisation, and it remains to be seen whether the utilisation of the grasslands for cultivation and grazing and the wider burning of the grass will prevent the development of swarms. Incipient swarms should be destroyed by means of baits or dusts. In laboratory tests, fine derris dust with a rotenone content of 2–4 per cent. was lethal to hoppers and adults.

It is possible that the outbreaks in the Philippines may be at least partly due to swarms from Borneo, where outbreaks have preceded those in the Philippines [*cf.* **24** 233], and whence the swarms may migrate by way of the Sulu Archipelago or Celebes and Cotabato.

A discussion and tables are included of biometrical measurements and ratios of *L. m. manilensis*, ph. *solitaria*, collected over a number of years in the Philippines, as well as of those of phases *transiens* and *gregaria* [*cf.* **24** 233; **25** 711].

Otanes (F. Q.) & Karganilla (L. T.). **Insect and other Pests of Corn.**—*Philipp. J. Agric.* **11** no. 4 pp. 403–430, 8 pls. (3 col.), 21 refs. Manila, 1940.

This paper on maize pests in the Philippines includes descriptions of most of the insects dealt with and of all stages of the more important species as well as notes on their bionomics and control. Those most injurious in the field are *Locusta migratoria manilensis*, Meyen, *Pyrausta nubilalis*, Hb., *Heliothis armigera*, Hb., and cutworms and armyworms. The bionomics and periodicity of *L. m. manilensis* are briefly outlined [*cf.* preceding abstract]. The egg stage lasts 12–25 days and hopper development 36–66; the first mating takes place 22–34 days after adult emergence and oviposition begins 1–2 weeks later. The hoppers can be destroyed by driving them into pits, or by sprays of soap solution, dusts of derris or of calcium arsenate, or poison baits. The need for fundamental ecological investigations in the outbreak areas in Cotabato and Davao, on the island of Mindanao, is stressed. Brief notes on the bionomics of *P. nubilalis* [*cf. R.A.E.*, A **17** 265] are followed by suggested control measures, which include the destruction of infested plants at short intervals and of stalks and stubble immediately after harvest, planting the most resistant varieties that give high yields, and the use of fertilisers, crop rotation and cultivation. *H. armigera* should be controlled by cultural measures similar to those used against *P. nubilalis*, by planting varieties with tight-fitting and long husks, by collecting the larvae, and by using light-traps or poison baits against the adults. The application of equal volumes of lead arsenate or calcium arsenate and finely ground sulphur to the silks at intervals of 3–4 days until the ears are ready for use is also suggested.

The cutworms and armyworms that have been observed feeding on maize are *Spodoptera mauritia*, Boisd., *Prodenia litura*, F., *Cirphis*

unipuncta, Haw., and *Agrotis* sp. Outbreaks of *Spodoptera* occur almost every year; the larvae attack rice as well as young maize plants, sometimes destroying whole fields. Control measures against any of these Noctuids should be carried out as soon as signs of infestation are noted; they include dusting heavily infested weeds or crops with lead arsenate or calcium arsenate, protecting uninfested fields by digging steep trenches round them, and the use of poison baits.

The corn silk beetle, *Monolepta bifasciata*, Hornst. [which was erroneously recorded in a previous abstract as *M. varicornis*, Lec. (**27** 452)], feeds on the maize silks, preventing pollination, on the young leaves of a number of other plants, including mango, avocado, cassava and castor [*Ricinus communis*], and on mango blossoms. The period of abundance of the beetles should be observed in each locality, and the maize should be planted at such a time that the silk and tassels are not produced during this period. Before the tassels appear, light-traps should be used to catch the adults, and trap crops, preferably cassava, should be planted, the beetles that gather on them being destroyed by means of poison sprays or light-traps. The silks of maize may be dusted with lead arsenate or calcium arsenate early in the morning. The larvae of the Melolonthid, *Leucopholis irrorata*, Chevr., feed on the roots of rice, maize, sugar-cane, mango seedlings, pineapple and other plants. The adults feed chiefly on the leaves of mango and also on those of banana, bamboo and sugar-cane. The life-cycle lasts about a year near Manila and in central Luzon, where the adults begin to emerge during April or May, and sometimes in March, after the first heavy rains [*cf.* **14** 94; **15** 552], but in Occidental Negros there appear to be two generations, of which the adults occur in November–December and April–June. Control measures comprise collecting the larvae when the land is ploughed, allowing fowls and other birds to feed on the grubs turned up during ploughing, digging up the larvae round dying or wilting plants, collecting the adults by shaking the trees on which they feed as soon as they appear, and encouraging the propagation of parasites, such as *Campsomeris aureicollis*, Lep., by allowing nectar-bearing shrubs, including *Stachytarpheta jamaicensis*, to grow at the borders of the fields.

The Delphacid, *Peregrinus maidis*, Ashm., prefers young maize plants. Injury appears first on the upper surface of the midrib near its junction with the stalk, and infestations often spread to the unfolding buds. The eggs are usually laid in groups in longitudinal slits on the upper surface of the leaves, near the stalks, and the newly hatched nymphs travel down the leaf to the stalk, and have been stated to develop in the moisture at the base of the leaf. The nymphal stage lasts 16 days. The Derbid, *Proutista moesta*, Westw., is common on maize and sugar-cane, but rarely causes much injury. *Aphis maidis*, Fitch, feeds on the sap of the young and tender leaves, and severely infested plants droop and may die, but it is usually controlled by natural enemies, such as Coccinellids and Syrphid larvae. Serious damage to maize by *Frankliniella williamsi*, Hood, has been reported from Ilocos Sur and Batangas, but injury appears to occur chiefly on late-planted maize suffering from lack of moisture because the dry season has begun. The last three insects can be controlled, if necessary, by spraying with soap solution and nicotine sulphate or derris powder. The larvae of a species of *Agromyza* mine the leaves of maize, but most of the larvae are parasitised.

The chief pest of stored maize is *Calandra oryzae*, L. [*cf.* **22** 257], which also attacks maturing ears with poorly developed and damaged husks. Varieties of maize that produce well-developed ears with tight-fitting husks should be planted, but the ears must be dried before storing. Damage by *Sitotroga cerealella*, Ol., is sometimes severe, though it is primarily a pest of stored rice. Other Lepidoptera that infest stored maize or maize products are *Corcyra cephalonica*, Staint., *Ephestia cautella*, Wlk., *E. kuehniella*, Zell., and *Plodia interpunctella*, Hb. All these insects can be controlled by fumigation or by installing pipes in the storerooms so that they can be heated by steam to a temperature of 120–150°F. for three hours or more.

Rivnay (E.), Nadel (M.) & Littauer (F.). **The Reaction of the Orange Fruit to the Autumn Attack of the Mediterranean Fruit Fly and its Economic Status.**—*Hadar* **11** no. 11 repr. 16 pp., 1 fig., 3 refs. Tel-Aviv, 1938. [Recd. 1941.]

Orange fruits in Palestine are attacked by the Mediterranean fruit-fly [*Ceratitis capitata*, Wied.] in early autumn, winter and spring [*cf. R.A.E.*, A **28** 270] ; the winter infestation may be of little economic importance, but the other two cause considerable loss, owing to damage to the fruit and interference with picking and shipping. The author uses the term infested fruits to include those in which eggs have been deposited, whether or not the larvae hatch and become established [*cf.* **26** 406]. In spring, infestation occurs when the fruits are ripe, the oviposition puncture is not visible from outside and there is little mortality of the larvae in the rind, but in autumn, when the fruits are not mature, larval mortality is great and the oranges are conspicuously marked at the site of oviposition. In view of doubts as to whether oviposition in autumn by *C. capitata* is the cause of fruit fall, the extent and cause of larval mortality in early infested fruits, and the degree to which infestation renders oranges more susceptible to infection by *Penicillium* [*cf.* **26** 406], investigations were carried out over several years in the coastal plain of Palestine. It is pointed out that the results do not necessarily hold good for the Jordan Valley, where the climate is warmer, or for mandarin oranges or grapefruits, which ripen at a different time and have not the same type of skin structure.

Experiments on fruit fall were carried out from the end of September to November 1936 and again in the autumn of 1937. Batches of 3–5 pairs of flies were enclosed for 2–3 days on fruits, and the trees were examined at intervals. In 1936, none of the 50 infested oranges dropped ; the last was removed from the tree after 75 days. In 1937, 67 oranges were exposed to attack ; 7 of these subsequently dropped, but 5 of them contained living larvae in the pulp. The other fruits were left on the trees for up to 88 days after oviposition by the fly. Observations in groves in which fruit fall was alleged to have been caused by *C. capitata* showed that early infestation occurs on trees suffering from lack of water, that many unpunctured fruits dropped from the trees, and that when maturing fruits on a healthy tree are attacked they remain on it for a long period.

In investigations on larval mortality, 141 oranges were examined in December 1934 and January 1935 ; the 294 oviposition punctures on

them were found to contain 63 dead eggs and 846 dead larvae, 1,226 larvae had died after penetration into the rag (albedo) and 89 living larvae were found in the pulp of 8 fruits (5·5 per cent.). Of 3,000 oranges examined in December 1936 and November–December 1937, only 18 (0·6 per cent.) contained living larvae in the pulp. The higher percentage in 1934 is considered to have been due to the later date of picking and to higher winter temperatures that hastened the ripening of the fruit. In unripe oranges, the rag is tough and offers strong resistance to the burrowing larvae, which often become exhausted before reaching the pulp, while the gum exuding from the injured tissues sometimes drowns them. In ripe oranges, in which the rag is soft, no gum escapes from damaged tissue and the percentage larval mortality decreases as the season advances, while the percentage of fruit containing live larvae increases. The date at which the fruit matures and becomes less resistant to larval penetration is influenced by many factors, but oranges appear to be generally resistant to the survival of larvae in this district until the middle of November. In ripe yellow oranges, the site of oviposition cannot be easily distinguished, but in green or unripe ones the area surrounding it undergoes a series of colour changes, a description of which is given. Histo-chemical examinations showed that the oviposition cavity and the larval burrows in the rag become lined with cork and are often completely clogged with the gum exuded from wounded tissues. No correlation could be established, however, between the outside appearance of the puncture and conditions within it.

Experiments were then carried out to determine whether oviposition early in the season predisposes oranges to attack by *Penicillium* under conditions approximating those of transport to foreign markets. In the first series, infested fruits were collected in the grove, packed as if for shipping, retained for 2–3 weeks in a room in which the temperature fluctuated from 15 to 23°C. [59–73·4°F.] and examined after 10–16 days. The results showed that very few infested oranges became infected with *Penicillium*, and that where the fungus was present it had not entered through the oviposition punctures. In the second series, the oranges were grouped according to the condition of the oviposition punctures and subjected to infection with *Penicillium* on 30th November 1937 by placing dry spores on the surface of the puncture, by placing a suspension of spores on it, and by pricking with an infected needle 3 mm. deep into the oviposition cavity. Uninfested oranges were similarly treated, and examinations were made on 6th and 15th December. The fruit was in general still resistant to the fungus, and the only infections in the controls (16 per cent.) resulted from inoculation by needle. The infested oranges showed great resistance to infection by spores placed over the puncture, and in the case of inoculation by pricking, showed even greater resistance than the controls. Fruits that showed a brown spot round the oviposition puncture were the most susceptible to infection. The experiment was repeated on 16th December with oranges picked the previous day, but only inoculation by needle was tried. The percentage infection in the controls was 76, and this increased susceptibility was probably due to the more advanced stage of ripeness of the fruit ; fruits infested by *C. capitata* were all more resistant to the fungus than the controls, the percentage infection ranging from 8 in fruits showing a green dot round the oviposition puncture to 20 in those showing a brown spot, and this comparative resistance was confirmed in a further

test with oranges picked on 29th December. It is considered to be due to the healing processes (formation of cork and exudation of gum) that take place in the punctures.

KLEIN (H. Z.). **The Chaff Scale** *Parlatoria pergandei* **var.** *camelliae* **Comst.**—*Hadar* **12** no. 6 repr. 8 pp., 2 figs., 3 refs. Tel-Aviv, 1939. [Recd. 1941.]

One of the pests of *Citrus* in Palestine that have increased in importance with the ageing of the trees is *Parlatoria camelliae*, Comst. Brief descriptions are given of the adults of both sexes, the scale of the male pupa and the egg of this Coccid, and it is stated that whereas in other parts of the Mediterranean region it infests various economic plants, in Palestine it has been observed only on *Citrus*, particularly oranges of the variety Shamouti. On the coastal plain it has three generations a year, young larvae appearing in the periods April–June, August–September and November–January. The eggs are deposited on the leaves and fruits, and development from hatching to the adult stage lasts from 6 weeks to over 4 months in winter. Scale populations are greatest in late winter and lightest in early summer as a result of the hot Khamsin winds. In most cases, the infestation begins when the trees have reached their eighth year, and it is heaviest in the central part of the tree, where there is the greatest amount of shade. No chlorotic stains or defoliation as a result of infestation have been observed. Owing to their small size and inconspicuous grey colour, small numbers of scales do not mar the appearance of the oranges, and fruits bearing 20–30 Coccids each frequently pass inspection for export, but when large numbers occur on the fruits, green stains appear round the infested parts. Reports received in 1937–39 from a number of localities on the coastal plain indicated that nearly 5 per cent. of the fruits were badly infested with *P. camelliae* and unfit for export. Counts made at intervals from December to April at Hedera showed that the percentages of culled fruits infested with it in three groves, 11–13 years old, averaged 0·9, 0·4 and 0·3, which indicated that only a very small proportion of the fruit is rendered completely unfit for export owing to infestation. There is considerable degrading, however, and 10 per cent. of the oranges from the two untreated trees in the experiment noticed below were classed in lower grades than the first as a result of infestation, which represents a considerable economic loss.

In August 1938, 500 trees planted in 1928 were sprayed with white-oil emulsion and 500 planted in 1927 fumigated with hydrocyanic acid gas. It was not possible to determine the mortality of the Coccids on the fruits, owing to the low populations present, but at the end of February, when infestation is at a maximum, the entire crop on two trees from each treated plot was picked and classified. Of the fruits from trees sprayed with 1·5 and 1·75 per cent. white-oil emulsion and those fumigated, respectively, 89·8, 92·3 and 99·8 per cent. were uninfested, 9·4, 7·0 and 0·2 per cent. were infested but fit for packing, and 0·8, 0·7 and 0 per cent. were infested and unfit for packing, while in the untreated controls these percentages were 77·9, 20·3 and 1·8. In no case, however, was the cost of treatment justified by the saving obtained.

Owing to a prevalent belief that *P. camelliae* had increased on exported fruit during transit to European markets, culled oranges

estimated to be infested with 20–25 Coccids each were taken from packing houses in mid-February, wrapped and packed as if for export and kept at 18–20°C. [64·4–68°F.] and 80 per cent. relative humidity, conditions that are more favourable for the development of the scale than those prevailing during sea transport. Examination after a month showed that 82·7 per cent. of the oranges bore less than 20–25 scales, 9·7 per cent. had more, while the rest were decayed from causes other than infestation by the Coccid. Only a very few scales were observed on many oranges in the first group, and it is possible that some of them may have been dry at the time of grading and have dropped to the ground during packing. Some fruits in the second group bore as many as 100 scales, but most of these were either adult females or empty male scales. Larvae were not observed on the fruit. The apparent increase in population was probably due to underestimation of the numbers on the fruits and the rapid development, under the favourable conditions provided, of young forms that escaped detection at the time of grading.

Natural enemies of the Coccid in Palestine include the Aphelinid parasite, *Aphytis maculicornis*, Masi, and the predacious Coccinellid, *Chilocorus bipustulatus*, L., but neither exercises any noticeable degree of control.

Rivnay (E.). **Studies on the Biology and Control of** *Pseudococcus comstocki* **Kuwana, on** *Citrus* **in Palestine.**—*Hadar* **12** no. 7 repr. 16 pp., 3 figs., 4 refs. Tel-Aviv, 1939. [Recd. 1941.]

This paper comprises an account of the bionomics of *Pseudococcus comstocki*, Kuw., on *Citrus* in Palestine [*cf. R.A.E.*, A **29** 339] and of experiments on its control, an abstract of which has already been noticed [**29** 73].

[Beĭ-Bienko (G. Ya.).]. **Бей-Биенко (Г. Я.). New or little known Orthoptera discovered in U.S.S.R.** [*In Russian.*]—*Mém. Inst. agron. Léningr.* 1941 no. 4 pp. 147–159, 3 figs., 15 refs. Leningrad, 1941.

The new species, which are described in Latin and Russian, include the Acridid, *Oedaleus asiaticus*, which has caused some injury to pastures in southern Transbaikalia. Species recorded as pests comprise the Tettigoniids, *Poecilimon scythicus*, Shchelk., on cucumber, potato and lucerne, and *Isophya vulgaris*, Miram, on wheat and lucerne, both in the Krasnodar region of the northern Caucasus.

[Reports of the scientific Meetings of the Leningrad Institute of Agriculture.] [*In Russian.*]—5 nos. Leningrad, 1940.

In "The selective Faculty of the Cotton Noctuid in Feeding and Oviposition in Relation to the Physiology of the Sense Organs" (4 pp.), I. D. Strel'nikov states that studies of the sense organs and reactions of *Heliothis armigera*, Hb., have shown that the larvae cannot distinguish food-plants at a distance and can recognise suitable food only after having tasted it. They thus tend to remain near the place where they hatch. The adults, on the other hand, acquire the ability to distinguish and find food in the course of a few days after emergence. In experiments, moths first reacted to chemical

substances, including food, at a distance of ½–5 cm., but those that had once reacted to an aromatic substance became able to recognise it at a distance 3–5 times as great. The newly emerged moths first encounter food accidentally, but after they have tasted it, the conditioned reflexes of the chemical sense produce a visual association that enables them to find probable sources of food at a considerably longer distance by their form or colour. They feed on the flower nectar of a great variety of plants, as well as on the sugary secretions of the extrafloral nectaries (as in cotton).

In the field, the moths must feed to mature their eggs, and the places in which they concentrate for feeding depend on a number of factors, such as the place in which they emerge, their selective ability and the distribution and properties of the food-plants. Egg-maturation, pairing and the bulk of oviposition all occur in the places of mass feeding. In Azerbaijan the larvae are, therefore, concentrated in summer and autumn on flowering plants in vegetable gardens. Eggs may also be deposited, however, on the dry parts of plants and on other objects. There is no evidence that the moths can select plants for oviposition by chemical reaction at a distance of more than about 3 ft. Organs of touch and chemoreceptors that react on contact are present on the second pair of tarsi and are of considerable importance in selecting a spot for oviposition on plants. The eggs are usually laid on plants that are covered with hair or have an uneven surface to which the moths can cling. The chemoreceptors come into play on plants, such as cotton, that have glandular secretions on the surface, and their reaction decides whether the moths remain on the plants and whether they feed. When the second pair of tarsi were removed or covered with varnish, the moths were unable to select a suitable spot for oviposition.

Observations and experiments showed that there is no ground for supposing that the attraction exercised by chick peas [*Cicer arietinum*] on the moths from cotton fields situated at some distance is chemical. In spring, when flowers are scarce, the moths cover large distances in search of food ; they probably notice the green strips of chick peas against the background of bare cotton fields, and find food and favourable microclimatic conditions in them. They remain and oviposit because their chemoreceptors react to, and they feed on, the solution of malic and oxalic acids in the dew on the plants. Lack of water increases their response to humidity, which they perceive by means of the antennae ; this explains the attractiveness of cotton for oviposition after watering.

More attention should be paid to the destruction of weeds that provide food for the moths in spring and autumn. The moths cannot be attracted from large areas by means of baits, as their chemical sense is little developed.

In " The Ecology of *Habrobracon brevicornis*, a Parasite of the Larvae of the Cotton Noctuid, and the Possibility of its practical Utilisation " (4 pp.), I. S. Skoblo states that in many cotton-growing districts in Azerbaijan considerable numbers of larvae of *Heliothis armigera*, Hb., are parasitised by *Microbracon* (*Habrobracon*) *brevicornis*, Wesm., and gives an account of laboratory investigations on its bionomics. It completed a generation in 6–9 days at 30°C. [86°F.] and in slightly over 9 days at 28°C. [82·4°F.]. The numbers of eggs deposited averaged 300–400 and the absolute maximum was over 800. Other conditions being equal, the number of eggs laid per day depended on

the number of host larvae available and ranged from 5 or less to over 50. Pairing usually took place on the day of emergence, and the eggs deposited by unfertilised females gave rise exclusively to males.

Individuals deprived of food, those given water only and those that fed on the body juices of the larvae lived for 3, 5 and 7 days, respectively, at high temperatures. The influence of relative humidity on the longevity of starved adults was marked only at low temperatures; at 13–15°C. [55·4–59°F.] and humidities of 0, 75 and 100 per cent., males survived for averages of 17·1, 40·4 and 29·7 days, respectively. When supplied with carbohydrates, the parasites lived for 50–70 days at 18°C. [64·4°F.] and longer at 13–15°C., and ovipositing females lived for an average of 26 days at 23–28°C. [72·4–82·4°F.]. Those prevented from ovipositing lived for an average of 30–35 days, and some for over 50 days at 28–30°C. The females readily inserted the ovipositor into and paralysed the larvae of various Lepidoptera, without ovipositing in them; at 28–30°C. individual females paralysed 10 or more larvae of the mill Pyralid [*Ephestia kuehniella*, Zell.] in 24 hours. At 40–42°C. [104–107·6°F.] the parasites still actively paralysed larvae, but not at 8–9°C. [46·4–48·2°F.]. In the absence of host larvae no eggs were laid, and the mature ones in the ovaries degenerated. When supplied with carbohydrates, parasites that did not oviposit lived a long time even at high temperatures, and their ability to do so enables them to survive in the field during periods when no host larvae are available. Females deprived of host larvae for 15 days laid eggs in the larvae soon after they were supplied, and their fertility was increased by almost 50 per cent. Of females prevented from ovipositing for about 30 days, up to 50 per cent. died at 28–30°C., but the survivors readily attacked larvae as soon as the latter were supplied. Females a month or more old paired and gave rise to a normal proportion of males and females, but when young females paired with old males, the progeny consisted of males only. Parasites that did not oviposit for 15–30 days lived very little longer than those that oviposited from the day of emergence.

All stages of *M. brevicornis* were very resistant to high temperatures irrespective of humidity. Development was normal at 30–35°C. [86–95°F.], but was somewhat retarded at 40°C. and about half the pupae died. The adults showed no signs of torpor at 40–42°C. The parasite is well adapted to the climatic conditions of Azerbaijan, where the summers are hot and dry, and also to the high humidity that occurs within the immature pods of chick peas and cotton bolls, where parasitised larvae of *Heliothis* are most often found. The adults are also very resistant to cold and probably overwinter in the field; in one experiment they survived exposure for about 3 months in the open to temperatures that gradually decreased from 6 to — 17°C. [42·8–1·4°F.], and revived when transferred to warm conditions. The pupae withstood cooling down to — 7°C. [19·4°F.], and eggs and larvae that had been kept for about 3 weeks at 6–2°C. [42·8–35·6°F.] developed normally. From data on the numbers of eggs, larvae and pupae of *Microbracon* found in cotton fields on larvae of *Heliothis*, and the rapidity of egg maturation, it is estimated that the moth could be controlled by releasing the parasite at the rate of about 4,000 females per acre.

In " The Existence of permanent Breeding Areas of the Central Russian Migratory Locust in the Tartar ASSR " (3 pp.), G. Ya. Beĭ-Bienko points out that in 1939 examples of the solitary phase of

Locusta migratoria rossica, Uv. & Zol., were found in open habitats with southerly exposures and light soils on the Volga terraces near Kazan. He concludes that permanent breeding areas of this locust exist in the Tartar Republic [*cf. R.A.E.*, A **29** 487], but as the climatic conditions in them closely approach those limiting the distribution of the species, exceptionally favourable conditions would be required to produce outbreaks.

In " An Experiment in controlling the winged Migratory Locust in the Delta of the Amu-Dar'ya " (2 pp.), A. I. Nikolaev states that control operations against the migratory locust [*Locusta migratoria*, L.] in the lower reaches of the Amu-Dar'ya, Turkmenistan, were carried out over nearly 330 sq. miles in 1938 and about 680 sq. miles in 1939. In spite of satisfactory results obtained in controlling hoppers in 1939, adult swarms appeared in the second half of July. In order to prevent them from invading cultivated areas and depositing eggs, an attempt was made to control settled swarms by applying calcium-arsenite dust from an aeroplane at the rate of 4½ lb. per acre when the locusts were feeding. As swarms are easily disturbed in the morning by an aeroplane, dusting was begun before dawn, light signals being used to guide the pilot. Flights of swarms occurred mostly at night, and regular observations were organised by the light of fires kept burning for 10–15 minutes every half-hour throughout the night to determine the direction of flight, its height, and the approximate size and density of the swarms. These data suggested probable stopping places of the swarms, which were then checked by surveys during the day. The results of the dusting could not be observed directly, as treated locusts fly away before dying, but a reduction in the number of locusts was established.

In " The Grey Grain Noctuid (*Hadena anceps* Bkh.) under the Conditions of northern Kazakhstan " (2 pp.), N. N. Marinov reports that outbreaks of *Apamea* (*Hadena*) *anceps*, Schiff., occurred in northern Kazakhstan in 1937–39 and caused considerable damage to wheat and rye. Little is known of the biology of this Noctuid, but observations in the region of Akmolinsk showed that the larvae hibernate in the soil at depths of not more than 4 ins. and pupate in spring in earthen cells so placed that the exit is level with the surface of the soil. In 1939, the adults appeared on 20th June, were most abundant on 4th–6th July and were present until 25th July. Eggs were laid in batches of 4–42 in the ears of wheat or rye ; no eggs were observed on leaves, stems or soil, or on barley or oats. On hatching, the larvae feed exclusively within the grains, but after the first moult they occur in the ears or in the axils of the leaves. They feed in the ears after sunset and are most active between midnight and 3 a.m. After harvest they congregate under heaps of straw left by the harvesting machinery, feed on the fallen grain and later hibernate. The grains of wheat and rye are attacked from the stage of milky ripeness, but barley and oats are attacked only during the period of waxy ripeness and injury to them is slight.

Control measures recommended are ploughing at the time of pupation, which destroyed up to 70·5 per cent. of the pupae, the removal from the fields of all remnants after harvest and the destruction of stubble. A poisoned bait of moist grain and sodium arsenite (using 19 parts poison to 1,000 parts grain by weight) broadcast in the field after breaking up the stubble killed about 86 per cent. of the larvae, but

if the stubble was not broken it killed only about 43 per cent. Deep autumn ploughing was ineffective against the larvae.

Ossowski (L.). **The Large Pine Weevil and Methods of Defence against it (with special Reference to the Methods adopted in the State Forests of Poland).**—*Scot. For. J.* **55** pt. 1 pp. 24–31, 5 figs. Edinburgh, 1941.

The methods adopted in conifer forests in Poland to prevent damage by adults of *Hylobius abietis*, L., are described and discussed with some reference to their application in British forests. The weevils are particularly injurious in plantations of Scots pine [*Pinus sylvestris*] between two and seven years old; larch, spruce and hardwoods growing among conifers are also attacked, but damage to hardwoods is seldom serious. In Poland, the adults begin to emerge from hibernation in March or April, but their wings are undeveloped and they fly rarely and only for short distances. Since only males were found during and after the emergence period in areas that had previously been cleared of weevils, it was concluded that the females are incapable of flight at that time. The eggs are deposited in dead stumps and the larvae remain under the bark until their development is complete.

Precautionary measures include uprooting dead stumps or, if this is not possible, stripping the bark from them to a depth of 2–3 ins. below soil level to prevent oviposition. Burning the stumps and spraying them with creosote are less satisfactory, since the parts below ground are not affected. Standing woods near young plantations should not be felled until the latter are over seven years old, and felled areas should be freed from infestation by means of trap logs before being replanted. The weevils are attacked by a number of birds and predacious insects, which should be protected.

Direct control measures comprise the use of protective trenches round young plantations and of logs, billets and pieces of bark as traps [*R.A.E.*, A **29** 593]. If infestation is severe, the weevils should be collected from them daily. The trenches should be 1 ft. deep and 1 ft. broad, with vertical sides, and should have trap pits, each 1 ft. long and 1 ft. deep, dug in them 15–20 yds. apart. They should be kept in good condition during the whole period in which they are in use (March–November). Fresh, split pine logs, 5 ft. long and 8–10 ins. in diameter, placed in shallow trenches to keep them damp and with the bark removed from the part touching the ground to induce a free flow of resin, remain effective traps for 2–4 weeks, depending on weather conditions, and should then be split on the upper side to keep them fresh for a longer time. In Poland, the average numbers used per acre were 24–32 among pines 3–6 years old and 4–12 in older woods. Trap billets 5 ft. long and 4–6 ins. in diameter with the bark removed from the part touching the ground are used like trap logs except that they are not split. They remain effective longer, but do not attract the weevils from so great a distance. If another strip of bark is removed and the billet turned over every two weeks so that the newly stripped wood is in contact with the ground, it will continue to be effective for two months. Where bark traps are used, fresh pieces of bark should be placed under them every 2–3 weeks; young pine twigs placed under the trap increase its efficacy. Experiments in Poland during 1936–38 with trap logs laid in or across short trenches 3 ft.

long and 1 ft. deep dug in various parts of the plantations gave unsatisfactory results, although this method has been adopted over large areas in Germany.

The author strongly recommends the use of several types of trap in each plantation, since no one measure is effective alone. Trap logs or billets and bark traps placed in old stands 2–4 years before felling reduce the populations before suitable breeding conditions arise.

LAIDLAW (W. B. R.). **Note on *Rhizophagus* and other Enemies of the Pine Bark Beetles** (*Myelophilus*).—*Scot. For. J.* **55** pt. 1 pp. 32–37, 1 fig., 8 refs. Edinburgh, 1941.

Brief notes, based partly on the literature, are given indicating that Nitidulids of the genus *Rhizophagus* are of some importance as predators of *Myelophilus minor*, Htg., and *M. piniperda*, L., on conifers in Britain, together with descriptions of the larval and pupal characters of the genus and the characters distinguishing the adults of *R. depressus*, F., and *R. dispar*, Payk., which are the commonest species. A table gives records of *R. depressus*, *R. dispar* and associated predators taken by the author on Scots pine [*Pinus sylvestris*] and other trees in Scotland during 1930–41. Those found on pine were predacious on *Myelophilus*, but except for the two species of *Rhizophagus* they are not specifically identified. An annotated list based on observations by the author and other workers of further parasites and predators that attack bark-beetles, probably including *Myelophilus*, in Britain is also given.

In notes on the bionomics and differences in form of the galleries of *M. minor* and *M. piniperda*, the author states that he has frequently found *M. minor* in stumps of matured Scots pine and larch, although it is recorded as preferring the upper thin-barked branches for breeding. Trees in which the flow of sap and resin is reduced by age, disease or injury, and logs and stumps of recently killed trees are preferred. Breeding begins in March, and the adults of the first generation emerge in May or June and attack the young shoots; some begin to breed under the bark in August, whereas others overwinter in the tunnelled shoots.

PAGE (A. B. P.) & LUBATTI (O. F.). **Recent Experiments on Fumigation.**—*Chem. & Industr.* **59** no. 11 pp. 172–179, 10 figs., refs. London, 1940.

Descriptions and diagrams are given of apparatus used in recent experimental work connected with the use of fumigants against insect pests in buildings and foodstuffs and other materials, and the technique of such experiments is discussed. The subjects dealt with include the determination of the concentration of fumigants in air, their transference through building and packing materials and their absorption on goods or porous material. The relative merits of different methods for determining the concentration of the fumigant in the main space of a fixed chamber and in such hidden spaces as the interior of packed goods or the spaces in hollow walls are compared, and a formula for calculating the error in sampling from hidden spaces produced by adulteration of the sample by gas drawn in from the main

space is given. The use of a series of time-concentration curves for representative positions to show the efficacy of fumigation is described and illustrated with different types of curves showing the changes of concentration in houses in the main space, cupboards, lath and plaster partitions and piles of absorbent material, in empty warehouses of varying construction, and inside goods packed in various ways. It is pointed out that distribution and penetration is greatly improved if goods are stacked in narrow piles with narrow alleyways between them.

Hero [Rosenthal (H.).]. **Ueber die Lebensbedingungen und die Bekämpfung des amerikan. Reismehlkäfers** *Tribolium confusum*. [The vital Conditions and Control of the Flour Beetle, *T. confusum*.] —*Schweiz. Mühlen-Anz.* **54** no. 38 pp. 2–3. Weinfelden, 1941.

Though *Tribolium confusum*, Duv., is a cosmopolitan pest of flour, little is known of the conditions under which it lives. Observations in Switzerland have shown that it is not harmed by temperatures between —3 and 39°C. [26·6 and 102·2°F.] or by a wide range of relative humidity and is very active at the higher temperatures. Low temperatures retard larval and pupal development and cause the adults to enter a state resembling hibernation. As a rule, only adults are present in winter, for oviposition takes place only at higher temperatures. Cold increases adult longevity. Temperature has a very marked effect on infestation, as reproduction occurs only between 29 and 39°C. [84·2 and 102·2°F.], the optimum for oviposition being about 36°C. [96·8°F.]. The optimum relative humidity is between 85 and 90 per cent., but an increase in population has been observed at 65 per cent. At 95–100 per cent. the beetles are killed by moulds. It is thus impossible for infestation to increase in flour that is kept cool (below 29°C.) and dry (below 65 per cent. relative humidity). If properly stored flour becomes infested from a badly stored supply, the beetles cannot reproduce in it and can be removed by sieving.

Lopez Cristóbal (U.). **Conservación de los granos almacenados. El " nuevo " método de los polvos silícicos.** [The Preservation of stored Grain. The " new " Method of siliceous Dusts.]— *Bol. Lab. Zool. agric. Fac. Agron. Univ. nac. La Plata* no. 5, 8 pp., 12 refs., multigraph. La Plata, 1940.

Reference is made to the successful use of inert dusts against pests of stored grain [*R.A.E.*, A **24** 341 ; **27** 585 ; **28** 476] and it is stated that experiments carried out in Argentina by A. R. Jurado for the Ministry of Agriculture showed that dusts containing over 60 per cent. silica arrest infestation by Coleoptera and Lepidoptera. The grain must be covered with a fine layer of dust, so that up to 4 per cent. in weight may have to be used. Whether an amount of silica dangerous to man remains in the flour milled from treated grain remains to be investigated. In the author's experiments, volcanic ash, of which large deposits occur in the Andes, was the best of various dusts, including imported products such as Naaki [**27** 582]. It adhered closely to the grain, had the finest texture, and its particles had the greatest number of sharp points. Another excellent material was the impalpable dust of a kind of quartz found in the Mar del Plata region and containing more than 95 per cent. silica.

The author has investigated the reason for the satisfactory action of inert dusts and gives in tables the results of many experiments with *Calandra* (*Sitophilus*) *granaria*, L., and *Sitotroga cerealella*, Ol., in stored grain. He concludes that the adults and larvae of *Calandra* and the larvae of *Sitotroga* die mainly of hunger, since the dusts fill their mouth-parts and prevent them from feeding. The adults of *Sitotroga* were unaffected by the dusts, but neither they nor the weevils oviposited on treated grain. There is no specifically toxic action involved. It was also shown that the treatment causes no reduction in the percentage of the grains that germinate, though it retards germination by about a week.

VRYDAGH (J. M.). **Note au sujet du** *Lasioderma serricorne* **F. (Cigarette Beetle).**—*Courr. agric. Afr.* **4** no. 10 pp. 1 & 4. Léopoldville, 1940. **L'***Asterolecanium coffeae*, **Newst., du** *Coffea arabica*.—*T.c.* no. 14 pp. 1 & 3. **Note au sujet de la cochenille de l'ananas** *Pseudococcus brevipes* **Ckll.**—*T.c.* no. 18 pp. 1–2. **Les fourmis du caféier** (*Coffea robusta*).—*T.c.* no. 24 pp. 1–3.

The first three of these papers consist almost entirely of reviews of data from the literature on the bionomics and control of *Lasioderma serricorne*, F., *Asterolecanium coffeae*, Newst., and *Pseudococcus brevipes*, Ckll. It is stated that, in the Belgian Congo, injury to stored tobacco by *L. serricorne* can be prevented, unless the storage is unduly prolonged, by proper construction of the warehouses and by suitable packing of the bales before transport. The information on *Asterolecanium coffeae* is taken from a paper already noticed [*R.A.E.*, A **21** 628]. This Coccid has recently appeared on arabica coffee in Ituri, the infestation having probably originated from Uganda. It had not previously been recorded from the Belgian Congo. *Pseudococcus brevipes* causes wilt on pineapple at Mvuazi in the lower Belgian Congo, and the author has recently observed it on celery in a kitchen garden at Bambesa.

The fourth paper contains notes on the habits and control of ants that occur on coffee in the Belgian Congo. The four types observed in Uele are *Oecophylla* spp., of which *O. smaragdina*, F., was the commonest; *Macromischoides aculeatus*, Mayr (and probably also related species); and two others, one a "poison ant," so-called on account of its exceedingly painful bite, and the other a Crematogasterine "paper maker". The ants cause no direct injury to the trees but hinder the harvesting of the coffee berries; unpicked berries become foci of infestation by the Scolytid, *Stephanoderes hampei*, Ferr. The author has obtained good control by the use of a poison bait very similar to one already noticed [**23** 171].

NAUDÉ (T. J.). **Work on the Control of Insect Pests. Annual Report of the Division of Entomology.**—*Fmg in S. Afr.* 1940 repr. no. 87, 4 pp., 1 fig. Pretoria, 1940.

During 1939–40, 792 colonies of eggs of *Cactoblastis cactorum*, Berg, were distributed in the Union of South Africa for the control of prickly-pear (*Opuntia*), thus bringing the total numbers so far distributed to 2,006 colonies [*cf.* *R.A.E.*, A **29** 17], comprising 495

million eggs. This Pyralid is now present in practically every important patch of prickly-pear, the first collapse of which has taken place in many localities and over an appreciable area. It appears that the second wave of collapse will materialise about three years after the first. Parasites of *Cactoblastis* comprising the Tachinid, *Phorocera blepharipa*, Br. & Berg. (a new record), four Ichneumonids and ten Chalcidoids (of which some are almost certainly hyperparasites) were of no particular importance, but the predacious ant, *Anaplolepis custodiens*, F. Sm., caused serious injury to colonies in some districts, and in one area where over 4 million eggs have been placed during the past seven years, the Pyralid is still a practically complete failure, apparently owing to this ant. Baboons and monkeys have destroyed about 30 colonies. The Pyralid has appeared in a number of plantations of spineless cactus. *Dactylopius opuntiae*, Ckll., made excellent progress. It gave very promising results on rondeblaar pear (*O. macracentra*) and did not appear much affected by an increase in numbers of *Cryptolaemus montrouzieri*, Muls., which is predacious on it. *D. confusus*, Ckll., continued to check the jointed cactus (*O. aurantiaca*), but was less effective under shady conditions.

The production of eggs of *C. cactorum* in the laboratory was improved by keeping the cocoons in heated cages. In the field, cocoons had a natural mortality of 30–70 per cent., a figure in close agreement with Australian findings. Waxed paper capsules proved satisfactory for use in distributing irregularly hatching eggs, such as those collected in the field.

Observations on *Argyroploce leucotreta*, Meyr., infesting *Citrus* showed that the parasites present are inadequate for control, and that females of this moth usually pair only once. The citrus weevil, *Sciobius granosus*, Fhs., was observed for the first time at Doornkop on fig trees, from which it has not previously been recorded. Blemishes on oranges caused by *Scirtothrips aurantii*, Faure, were heaviest close under the protection of a windbreak, whereas blemishes due to wind increased markedly as the distance from the windbreak increased. A bait-spray containing sugar and tartar emetic was very effective against this thrips within 1–3 days after application and remained effective for 10 days in the absence of rain ; sulphur dust [*cf.* **29** 18] was less effective and slower in action.

In preliminary tests of methyl bromide as a fumigant against *Ceratitis capitata*, Wied., in deciduous fruit for export, complete mortality of larvae and pupae was given by a dosage of 1 lb. per 1,000 cu. ft. Dosages of ½, 1 and 2 lb. were completely effective at 70–75°F. against *Cydia* (*Enarmonia*) *pomonella*, L., in pears and there were no indications of injury to the fruit. The use of an atomised spray of pyrethrum extract in white oil continued to give good results against *Ephestia elutella*, Hb., in dried-fruit warehouses, and is being adopted on a large scale. When atomised directly on to them in the laboratory, it killed 99, 98 and 92 per cent. of the eggs, larvae and pupae, respectively. Complete mortality of larvae and pupae was given by fumigation with methyl bromide at the rate of 3 lb. per 1,000 cu. ft. and an exposure of 12 hours and with hydrocyanic acid gas at 1 lb. per 1,000 cu. ft., maintained for 24 hours, with the pack left undisturbed for a further 24 hours. Investigation showed that sheds and storehouses on farms act as initial sources of infestation by *E. cautella*, Wlk., for Turkish tobacco in warehouses. Fumigation with hydrocyanic acid gas killed the insects near the surface, but the gas did not

penetrate the bales to any extent; methyl bromide was superior in this respect. In general, excellent control is being obtained in warehouses by routine spray of white oil containing standard extracts of pyrethrum.

There was a surprising improvement in some of the high-veldt plantations of *Eucalyptus* most seriously attacked by *Gonipterus scutellatus*, Gylh. [*cf. loc. cit*]. Pigs continued to afford good control of the Saturniid, *Nudaurelia cytherea capensis*, Stoll, in forests in the western Cape Province. It is concluded from preliminary tests that pyrethrum, derris and dinitro-ortho-cresol are very promising against the larvae in the third, fourth and fifth instars, while cryolite is good, calcium arsenate fair, and lead arsenate and calcium fluoride fairly good. *Pinus patula* was heavily infested by *Euproctis terminalis*, Wlk., over about 1,000 acres at Jessievale. In experiments with dusts against this Lymantriid, dinitro-ortho-cresol was promising and lead arsenate good. *P. patula* and *Acacia mollissima* over an area of about 5,000 acres were severely attacked by a Eumolpid of the genus *Colasposoma*, possibly *C. fulgidum*, Lef. The application of creosote to the lesions gave excellent results against the Metarbelid, *Teragra guttifera*, Hmps., on poplar, while a dust containing 5–10 per cent. pyrethrum applied at the rate of 10 lb. per acre was satisfactory against the froghopper, *Bythoscopus cedaranus*, Naudé, on *Acacia* [*cf.* **29** 278].

Delayed planting of maize continued to be of value against *Busseola* (*Calamistis*) *fusca*, Fuller. An outbreak of *Eldana saccharina*, Wlk., that occurred on sugar-cane in the Umfolozi area of Zululand in the spring of 1939 was successfully controlled, and this Pyralid was shown to have been long present in the district. The outbreak is regarded as sporadic and was probably favoured by delay in harvesting the cane. The introduced dry-wood termite, *Kalotermes* (*Cryptotermes*) *brevis*, Wlk., occurred in Durban and is now apparently firmly established in South Africa.

Some common Insect Pests of Fruit Trees and Vines in South Australia. Part II. Sucking Insects.—*J. Dep. Agric. S. Aust.* **43** no. 9 pp. 633–646, 22 figs. Adelaide, 1940.

This part of a continued paper [*cf. R.A.E.*, A **28** 229] comprises notes on the damage caused to fruit trees and vines in South Australia by sucking insects and mites, and on their life-histories and control there. Most of the Aphids that attack fruit trees are controlled by dormant washes of tar distillate (1 : 40) or red-oil emulsion (1 : 20) or by sprays of nicotine sulphate (1 : 800) with a spreader, or nicotine dusts applied after growth has begun. They include *Myzus persicae*, Sulz., which attacks peach, nectarine and other stone fruits, and *M. cerasi*, F., which occurs on cherry. Apterous females of these Aphids hatch in spring from eggs laid in autumn in the bud axils, and reproduce asexually. The infestation causes the young leaves to be curled and distorted. Peach trees become almost free from *M. persicae* by mid-summer as it migrates to annual plants, but *M. cerasi* remains on cherry throughout the year in South Australia. *Anuraphis persicae-niger*, Smith, also attacks peach and nectarine but has no egg stage in South Australia; the winter is passed on the root system and the summer on the foliage. *Eriosoma lanigerum*, Hsm., infests apple throughout the year, attacking the bark above and below ground. Root damage can be avoided by the use of resistant stocks, while

the parasite, *Aphelinus mali*, Hald., should be introduced into infested orchards for the control of the Aphid on the upper parts of the trees. In warm districts, this Aphelinid occasionally fails to establish itself, and in such cases dormant sprays of red oil or summer sprays of nicotine sulphate combined with white-oil emulsion (1 : 80) should be applied. *E. lanuginosum*, Htg., causes severe damage to the roots of pear, particularly on young stock. Though the primary food-plant, on which the overwintering eggs are laid, is elm, this Aphid probably lives on pear throughout the year in South Australia. No effective control measure is known.

The Coccids that attack fruit trees and vines in South Australia can usually be controlled by spraying with white-oil emulsion (1 : 40) when the young appear. *Aonidiella aurantii*, Mask., is the most serious pest of *Citrus* in the State, and relatively small numbers may severely damage the trees. It also attacks olive and some evergreen ornamental plants. Crawlers are produced in November and early December and from early February to March. When the infestation is light, one or two sprays, preferably in December and January, may be sufficient, but when it is heavy, the spray should be followed by fumigation two weeks later [*cf.* **27** 292]. Before treatment, weeds on which the scale may survive should be destroyed, and the lower branches should be trimmed so that they do not touch the soil. *Citrus* is also attacked by *Saissetia oleae*, Bern., which can generally be controlled by a single spray application, and *Icerya purchasi*, Mask., which is usually kept in check by native parasites, but is otherwise difficult to control [*cf.* **29** 280]. *Lecanium persicae*, F., on grape-vines, is also usually controlled by parasites ; if vines require treatment, they should be pruned heavily and sprayed with red-oil emulsion in winter or with white-oil emulsion in summer when the crawlers are present. *Lepidosaphes ulmi*, L., attacks apple and pear but is rare in South Australia ; it is usually controlled by dormant sprays of red oil applied against the mite, *Bryobia praetiosa*, Koch, but white-oil emulsion (1 : 80) is effective in summer if necessary.

The Coreid, *Mictis profana*, F., which attacks the young shoots of *Citrus* and some ornamental plants, can be controlled by spraying with nicotine sulphate in white-oil emulsion (1 : 60), which is effective against the nymphs, by hand picking or by killing the bugs that fall when the trees are shaken. *Nysius vinitor*, Bergr., which may sometimes attack fruit trees as weeds die off in spring and summer, and *Dindymus versicolor*, H.-S., which attacks vegetable crops and occasionally fruit trees, are controlled by removing annual weeds and spraying with the mixture of nicotine sulphate and white-oil emulsion. *N. vinitor* can be controlled on low growth by spraying with benzene or kerosene and burning. *Nezara viridula*, L., feeds mainly on vegetables, but was observed in 1938 on *Citrus* trees, on which it was probably hibernating. *Typhlocyba froggatti*, Baker, attacks various fruit trees, particularly apple [*cf.* **27** 292]. It overwinters in the egg stage in the bark of twig growth, nymphs hatch in spring and are found on the lower surfaces of the leaves, and adults appear at the end of October or in early November. They oviposit in the leaf veins and the adults of the following generation emerge in February. This Jassid curls and discolours the leaves by its feeding and disfigures the fruit with honey-dew, on which sooty mould develops. A single spray of nicotine sulphate, applied when the adults are first observed in spring,

gives effective control and can usually be combined with a spray against the codling moth [*Cydia pomonella*, L.].

Thrips imaginis, Bagn., attacks a wide range of plants, but the most important damage occurs on apple, particularly the late-flowering varieties. The eggs are laid in the flower tissue, and the nymphs feed in the flowers and pupate in the surface soil. The presence of large numbers of thrips prevents the setting of the fruit.

Bryobia praetiosa is found on most deciduous fruit trees, feeding mainly on the lower surfaces of the leaves. Dense masses of overwintering eggs are laid on the rough bark of the spurs and at the base of laterals; during summer the eggs are laid on the foliage and young laterals among the feeding mites. The trees should be sprayed in winter with red oil (1 : 20) as late as possible before the buds burst. White oil applied during the summer months for the control of other pests is of use against *B. praetiosa*, especially when nicotine sulphate is added. *Eriophyes pyri*, Pgst., blisters the leaves and sometimes the fruits of pear, but usually attacks only a small proportion of the trees; it overwinters in the bud scales. *E. vitis*, Land., causes similar damage to vines, and is similar in appearance and life-history, but more widespread. Both can be controlled by spraying with lime-sulphur (1 : 12) during the winter; sulphur applied during spring and summer tends to check *E. vitis*.

GIBSON (A.) & ROSS (W. A.). **Insects affecting Greenhouse Plants.**—*Publ. Dep. Agric. Canada* no. 695 (Fmrs' Bull. no. 94) 88 pp., 6 pls., 53 figs., refs. Ottawa, 1940. Price 25 *cts*.

The greater part of this publication (pp. 10–69) comprises descriptions of various stages and notes on the bionomics, food-plants and control of over forty different insect pests that attack greenhouse plants in Canada. Other sections deal with general recommendations on greenhouse hygiene, insecticides, methods of fumigation, pests other than insects, beneficial insects, and instructions for treating cases of poisoning that may occur during the application of insecticides.

MILLIRON (H. E.). **A Study of some Factors affecting the Efficiency of *Encarsia formosa* Gahan, an Aphelinid Parasite of the Greenhouse White Fly, *Trialeurodes vaporariorum* (Westw.).**—*Tech. Bull. Mich. agric. Exp. Sta.* no. 173, 23 pp., 10 figs., 47 refs. East Lansing, Mich., 1940.

The following is based largely on the author's summary of this account of experiments carried out in Michigan to determine some of the factors that increase or decrease the total parasitism of the greenhouse whitefly, *Trialeurodes vaporariorum*, Westw., by *Encarsia formosa*, Gah., the optimum conditions for parasitism and the economic importance of *E. formosa* in an average greenhouse environment. Brief notes are given on the origin, distribution and bionomics of the Aleurodid and of the parasite [*cf. R.A.E.*, A **15** 240], and the equipment and methods used are described. The highest percentage parasitism obtained was 91 on fuchsia and 86 on tomato. Temperature appeared to be the most important of the physical environmental factors affecting the efficiency of the parasite; humidity and light were also important. When temperatures were almost constant, the percentage parasitism was greatest on the majority of plants between

75 and 79°F., but it was somewhat higher when the temperature fluctuated widely between 57 and 81°F. At temperatures of 64° or less, however, the parasite was sluggish and gave little control. The relative humidity most favourable to it was 50–70 per cent. Its efficiency was impaired by pubescence on the leaves and by excretions of the food-plant or the Aleurodid. It normally attacks hosts that are in the fourth instar, but it was sometimes observed to oviposit in the second and third instars. Even in an environment extremely favourable to it, and although most of its generations consist entirely of females, its biotic potential is apparently lower than that of its host, especially during heavy infestations. Where a number of different plants are grown together, therefore, it seems unlikely that complete control can be obtained by means of the parasite, under normal greenhouse conditions. Under favourable conditions and when its population is large, however, it definitely checks the rapid increase of the Aleurodid.

HUMPHREY (E. N.). **Mechanised Dusting Equipment for Pea Weevil Control.**—*Bull. Idaho agric. Exp. Sta.* no. 234, 11 pp., 18 figs. Moscow, Idaho, 1940.

Rotenone dusts have been found effective in controlling the pea Bruchid [*Bruchus pisorum*, L.] in Idaho, but their successful use requires mechanised dusters and efficient operation. The qualities of 13 dusting machines operating near Moscow, Idaho, were observed during the summer of 1939, and the various units of equipment used in them are described and compared on the basis of effectiveness or value as related to operation of the entire machine. They were mounted on two- or four-wheel carts that were drawn by horses or a motor truck or tractor, or on wheel tractors, caterpillar tractors or trucks, and were driven by power take-offs from the tractors or by auxiliary motors. Blower power requirements ranged from 1½ to 8 horsepower, depending on the type of blower and accompanying mechanism. No material difference resulted in the use of low and high-pressure machines. Nozzle velocities varied greatly with little appreciable difference in effectiveness. Distribution nozzles and pipes were carried on long booms varying from 30 to 60 feet, the outer ends of the booms being supported on castor wheels or suspended from a boom tower. The use of the castor wheel required one man less for operation and maintained the hood at a fixed height above the peas. An average machine protected approximately 1,093 acres by dusting from one-third to one-fourth of each field. The caterpillar tractor was found to be the most satisfactory method of transportation on steep or hilly ground. Actual field damage from the use of dusting equipment varied from 1·99 to 3·50 per cent., the greatest amount of damage being caused by horse-drawn equipment or wide-tread caterpillar tractors.

PIERPONT (R. L.). **Rosin Residue Emulsion as a Sticker for Lead Arsenate in horticultural Sprays.**—*Bull. Del. agric. Exp. Sta.* no. 221, 35 pp., 2 figs, 5 refs. Newark, Del., 1939. [Recd. December, 1941.]

The following is substantially the author's summary of experiments in Delaware during 1936–38 to determine the value of an emulsion of

resin residue [*cf. R.A.E.*, A **24** 727] as an adhesive for lead arsenate in sprays against *Cydia* (*Carpocapsa*) *pomonella*, L., and *Polychrosis viteana*, Clem. Residue tests in the laboratory, in which this emulsion was included with lead arsenate and various fungicides in representative spray combinations for use on apple, peach and grape, showed that it improves the efficiency of the sprays by producing a more even coverage and by increasing arsenical adherence. It caused foaming in combinations in which hydrated lime was included, but this did not cause any mechanical difficulties in the laboratory or in the field.

In experiments in typical apple orchards, resin-residue emulsion was used with lead arsenate and various fungicides on a rather complete seasonal succession of varieties. When employed at the rate of 1 pint per 100 gals. in four cover sprays against first-generation larvae of *C. pomonella*, it was as effective as Menhaden fish oil and certain commercial adhesives now recommended in the apple-spraying programmes of Delaware and other States. In general, its addition to the base sprays resulted in a profitable increase in clean and marketable fruit and a reduction in the larval population. Chemical analyses of fruit samples taken at harvest indicated that the arsenical residue at that time was not great enough to prohibit the use of the emulsion ; in some cases it exceeded that allowed by the regulations, but the excess was readily removed by washing.

Resin-residue emulsion aided in producing a more even coverage on both foliage and fruit of apple trees and grape vines. It was used with lead arsenate combined with Bordeaux mixture and with Coposil [copper aluminium silicate] in experimental spraying in typical vineyards, and was more efficient than Menhaden fish oil and certain commercial adhesives when employed in a complete spray programme against *P. viteana*, at the rate of 2 pints in 100 gals. When it was used at the rate of 1 pint per 100 gals., the results compared favourably with those obtained with Menhaden fish oil at the same rate. In general, the addition of resin-residue emulsion, Menhaden fish oil and the commercial adhesives to the base sprays resulted in an increase either of clean grapes or clean clusters. The use of the emulsion did not result in any discoloration or injury on foliage or fruit.

Department of Entomology.—*Bull. Del. agric. Exp. Sta.* no. 227 (Rep. 1939–40) pp. 21–30. Newark, Del., 1940.

Maize pests in Delaware during the year ended 30th June 1940 included *Pyrausta nubilalis*, Hb., which occurred in all three counties [*cf. R.A.E.*, A **29** 508], *Heliothis armigera*, Hb., *Diatraea crambidoides*, Grote (*zeacolella*, Dyar) and *Laphygma frugiperda*, S. & A., which were unusually abundant in the south-east, and *Prodenia ornithogalli*, Gn., which caused serious injury to young plants in the north in June. *Coleophora malivorella*, Riley, was more abundant than usual in apple orchards in central Delaware during the spring. *Monoptilota nubilella*, Hulst, was observed in the State for the second time in ten years in June 1940 on a farm on which it destroyed more than half a large planting of pole lima beans. The removal of infested terminal vines and the destruction of spent vines after harvest followed by light cultivation in autumn and deep ploughing in spring might be of value against this Pyralid where infestation is limited, but would be impracticable over a large area. *Harmolita tritici*, Fitch, was observed

for the first time in Delaware in late July 1939, when it was taken on wheat stubble.

A study of the dates of emergence of *Cydia* (*Carpocapsa*) *pomonella*, L., in apple orchards in Delaware over a ten-year period has established that, in each year, half the moths of the overwintered generation have emerged and peak emergence takes place on a date within the four days preceding or following 20th May. Since the date of application of the petal-fall spray coincides approximately with that of the first appearance of the adults, and since emergence normally continues for 45 days, reaching a peak approximately 10 days after petal fall, it is possible to predict the date on which spray-cover is necessary for effective control of the first-generation larvae. A spray programme in which a fixed nicotine (Black Leaf 155) and oil were substituted for lead arsenate gave control equal or superior to that given by the standard lead-arsenate schedule, but was more than three times as costly. No marked benefit resulted from supplementing the lead-arsenate schedule with one or more applications of fixed nicotine and oil.

Cydia (*Grapholitha*) *molesta*, Busck, caused little damage to peach during the year. Parasitism of the larvae reached 70 per cent. in 1939, which is well above the average [**28** 571].

Under conditions of high humidity, heavy applications of dusts containing lead or calcium arsenate against *Anthonomus signatus*, Say, on strawberries caused severe injury to the foliage when the carrier was sulphur, but not when it was a silica dust (Celite) [**28** 519], which however, leaves a conspicuous residue if applied rather late in the season.

Department of Horticulture.—*Bull. Del. agric. Exp. Sta.* no. 227 (Rep. 1939–40) pp. 30–34. Newark, Del., 1940.

Experiments were carried out in Delaware in 1940 to determine the extent to which the premature drop of young fruits of peach and apple is affected by the mechanical injury caused by ovipositing females of the plum curculio [*Conotrachelus nenuphar*, Hbst.] and the use of nicotine sulphate as an ovicide. The oviposition injury was imitated by stabbing young and apparently healthy fruits in one or five places with a pocket knife. The data indicated that mechanical injury may cause slight dropping in peaches, but not in apples, and that five punctures caused no more drop than one. Applications of nicotine sulphate to the injured fruits did not increase the number that dropped prematurely.

Flint (W. P.) & Farrar (M. D.). **Protecting Shade Trees from Insect Damage.**—*Circ. Ill. agric. Exp. Sta.* no. 509, 59 pp., 45 figs. Urbana, Ill., 1940.

This circular contains notes on the bionomics, appearance of the injurious stages and control of insects that commonly attack shade trees in Illinois. They are arranged under the trees that they infest, and a few of those that attack evergreen landscape trees are included. Brief sections on insects that are potential pests but have not yet been recorded in Illinois and on the special equipment needed for spraying shade trees are appended.

PARR (T.). *Asterolecanium variolosum* **Ratzeburg, a Gall-forming Coccid, and its Effect upon the Host Trees.**—*Bull. Sch. For. Yale Univ.* no. 46, 49 pp., 15 pls., 83 refs. New Haven, Conn., 1940. Price 75 *cts.*

The following is based largely on the author's summary. *Asterolecanium variolosum*, Ratz., has been recognised as a pest of oak in Europe for over 100 years and has now spread to all parts of the world in which its food-plants occur. Several species of the white-oak group are attacked, *Quercus robur* being the favoured food-plant. In the north-eastern United States, chestnut oak (*Q. montana*) is the species most commonly infested, associated white oaks also being attacked. Young trees 6–10 ft. high are the most seriously affected, although, in combination with other factors, the Coccid may kill large trees. It has only one generation and one brood a year in the north-east, and it is both ovoviviparous and parthenogenetic in Connecticut, though it is stated in the literature to be oviparous [*cf. R.A.E.*, A **28** 441]. No males were observed by the author. Production of young is distributed over a considerable period during the warm months. The nymphs feed within a few days of emerging from the female, and once the stylets are inserted in the plant tissues the insect never moves, and, if removed artificially, is unable to reinsert the stylets. No moult occurs before feeding begins, and there are only two moults during development. The winter is passed in the adult stage. On branches $\frac{1}{4}$–2 inches or more in diameter, a population of over 50 insects per square inch of bark surface will probably cause death, and one of over 100 insects is certain to kill the branch. On smaller twigs, where the galls frequently coalesce, a much lighter population will kill the twig.

A study of serial sections of food material showed that factors other than the withdrawal of cell contents by the insect are of greatest importance to the tree attacked. A true gall is formed, the greatest proliferation taking place in the collenchyma. Eventually the area affected, which includes the epiderm, cork cambium, collenchyma, phloem and cambium, dies. In a light infestation, this area may callus over and again become infested. The stimulus for gall production is chemical in nature and was produced by injections of salivary extract from the insects. Failure of heated salivary extract to produce galls points to an enzyme or enzyme-like substance or group of substances as the cause of gall formation. The results of a quantitative analysis of the activity of two enzymes from the salivary glands are given in tables. Qualitative tests showed the presence of amylase, invertase and proteases in the salivary glands. Cellulase was absent. In the plant tissue itself, starch gradually disappears as the gall develops, and its place is taken by glucose and sucrose, which are later removed by the insect. Tests indicate the presence of proteases in the gall, strongest around the stylets and gradually diminishing in strength towards the periphery of the proliferated tissue. Oxidases increase in activity in the gall during the growth period and then diminish. Coincidental with the lowering of oxidase activity is an increase in tannin content of the affected area.

MORRILL jr. (A. W.) & LACROIX (D. S.). **Report on Insect Investigations for the 1938 Season.**—*Bull. Conn. agric. Exp. Sta.* no. 433 pp. 186–193, 3 figs., 2 refs. New Haven, Conn., 1940.

Work on insect pests of tobacco in the Connecticut River Valley in 1939 included experiments on the control of wireworms by means of

naphthalene ploughed in at the rate of 800 lb. per acre, which had given almost complete control in a single plot in 1937 [*R.A.E.*, A **27** 178]. The application was made on 1st May, six weeks earlier than in 1937. The soil temperature was then 49°F., and six weeks later, when it had risen to 70·5°F., the wireworm population was reduced by 48 per cent., which was statistically significant. The control was inadequate, however, probably because the low temperatures had prevented sufficient naphthalene from being vaporised before 1st June.

Adults of *Popillia japonica*, Newm., were observed feeding on shade-grown tobacco for the first time in two fields on 17th July; only the top leaves were attacked and injury was negligible in spite of the number of adults. The beetles were also present on wild grape-vines and weeds surrounding the shade-tents, but those taken to the laboratory preferred tobacco leaves to vine leaves. Sun-grown tobacco was also slightly attacked in several plantations. The wireworm, *Pheletes ectypus*, Say (*Limonius agonus*, Say), was injurious during the early part of the season, and *Hylemyia cilicrura*, Rond., caused some damage in isolated fields. *Epitrix cucumeris*, Harr., was abundant until mid-June, but the summer brood was small. Tobacco planted near potato fields was very severely damaged; in both 1938 and 1939, plants at the edge of fields adjoining potato fields were often almost completely skeletonised. *Frankliniella fusca*, Hinds, was very abundant and injurious throughout the Valley.

Experiments were carried out on shade-grown tobacco in June–July with dusts and sprays containing cubé or pyrethrins in an attempt to develop a treatment effective against both *E. cucumeris* and *F. fusca*, and the dusts were further tested on sun-grown tobacco in July. They consisted of exhausted pyrethrum impregnated with 0·5 per cent. pyrethrins, cubé diluted with tobacco dust to a rotenone content of 1 per cent., and the same cubé mixture with the addition of a proprietary wetting agent. In the tests on shade-grown tobacco, all the dusts were more effective than the sprays against *Epitrix* and gave a significant reduction in infestation and damage by it, but the pyrethrum dust was the only treatment that gave significant results against the thrips. Details of these experiments are given, but no recommendations are based on them, because of the exceptionally dry conditions under which they were carried out. On the sun-grown tobacco, the dusts were applied six times between 14th and 31st July, inclusive. The pyrethrum dust was more effective against each insect than the cubé dusts, and the cubé dust was more effective when it contained no wetting agent.

Michelbacher (A. E.), MacLeod (G. F.) & Hoskins (W. M.). **Investigations of Caterpillars attacking Tomatoes in northern California during 1939.**—*Bull. Calif. agric. Exp. Sta.* no. 644, 20 pp., 6 figs., 6 refs. Berkeley, Calif., 1940.

The information in this bulletin is intended to supplement that contained in previous ones [*R.A.E.*, A **27** 431; **28** 14]. The results of surveys of infestation by *Keiferia* (*Gnorimoschema*) *lycopersicella*, Busck, *Heliothis armigera*, Hb., and *G. operculella*, Zell., in tomato fields in 13 counties in northern California in the 1939 season are given in a table, and the distribution of *K. lycopersicella* in the same area is shown on a map. *Protoparce sexta*, Joh., and *P. quinquemaculata*, Haw., were less, and *Laphygma exigua*, Hb., more, injurious to tomato

than at any time since the investigations began in 1935. In experiments, dusts of undiluted calcium arsenate were very effective in controlling the Sphingids. In several fields, the fruits, especially those resting on the ground, were damaged at night by undetermined armyworms that sheltered in the soil or among débris during the day.

Observations on the behaviour of *H. armigera*, infestation by which was more severe than in 1938, indicated that adults that emerge where food-plants in a condition suitable for oviposition are plentiful make only short flights, but those that emerge where suitable plants are scarce may migrate for considerable distances, sometimes passing the nearest suitable breeding grounds. Evidence was also obtained that populations are built up on other crops and migrate to tomatos late in the season when the other food-plants are no longer available. Experiments on control were continued with dusts of undiluted calcium arsenate or of natural cryolite (54 per cent. fluorine) and talc, which were applied on 8th and 27th September and 12th October to plants in experimental plots. Calcium arsenate (12, 11 and 17 lb. per acre for the successive applications) was the most effective in reducing the percentage of injured fruit. A dust containing 80 per cent. cryolite (16, 18 and 18 lb.) was almost as effective as a heavy application (33, 28 and 39 lb.) of one containing 40 per cent., the total amount of fluorine applied during the season being approximately the same in both treatments, and both were more effective than a lighter application (19, 21 and 20 lb.) of a dust containing 40 per cent. cryolite, which provided only about two-thirds as much fluorine during the season. Analyses were made of the deposits, and data are given on the amounts of arsenic and fluorine on dusted leaves at various times during the harvest season. Calcium arsenate was more effective in forming a deposit and adhering to the foliage than cryolite, and the superior control given by it is probably due in part to this. The deposit from the heavy application of 40 per cent. cryolite dust was no heavier than that from the lighter applications, and increased control was in this case probably due to the more even distribution obtainable with the larger quantity. Experiments on the removal of residue showed that if the fruit is heavily covered with dust, owing to poor application, the normal washing process at the cannery is not adequate to remove the arsenic ; residues were less easily removed from bruised than from unbruised fruit.

Entomology and Zoology.—*Rep. S. Carolina Exp. Sta.* **53** (1939–40) pp. 60–68, 4 figs. Clemson, S.C., 1940.

F. Sherman and W. M. Upholt record work in South Carolina on the susceptibility to infestation by the cowpea curculio [*Chalcodermus aeneus*, Boh.] of different varieties of cowpeas [*cf. R.A.E.*, A **28** 649]. Five varieties maturing at different times were planted on 1st June 1940, and the estimated total number of larvae in 1,000 mature pods ranged from 179 to 877. The degree of infestation differed more with the variety than with the date of harvesting. There was some discrepancy between the results and those obtained in Georgia [**29** 598].

O. L. Cartwright reports that damage to peach by the oriental fruit moth [*Cydia molesta*, Busck] was slightly more severe in 1940 than during the preceding season. The percentage of fruits infested at harvest averaged about 2 in most commercial orchards and ranged up to 14. The rate of parasitism, however, was higher than in any

previous year [*cf.* **28** 649]. *Macrocentus ancylivorus*, Rohw., was recovered in numbers in two counties in which it had been released in 1938, and parasitised 76·6 and 73·9 per cent. of the larvae in two localities in June and 50·6 per cent. in a third in July. The native parasite, *M. delicatus*, Cress., gave 58·3 per cent. parasitism in one locality in July and 71·8 per cent. parasitism in another in August.

Sherman, Cartwright, J. G. Watts & Upholt describe investigations on the bionomics and control of the tomato fruitworm [*Heliothis armigera*, Hb.] begun in the spring of 1940. In breeding experiments, the egg, larval and pupal stages averaged 3·5, 27 and 14 days, respectively, and the duration of development from egg to adult was 32–63 days. Mass production of uniform larvae for control experiments was hindered by the failure of many moths to lay large numbers of eggs and the habit of the larvae of feeding on each other, which necessitated the rearing of individual larvae in separate cages. In control experiments, 30 chemicals were fed on leaf squares to third-instar larvae that had been starved for 18 hours; 9 of them gave promising results, and at least 7 of the 10 larvae tested with each of them died within 5 days when the poison was air-floating Paris green, dinitro-ortho-cyclohexylphenol, dinitro-ortho-cresol, barium fluosilicate, a proprietary sodium fluosilicate or lead arsenate. The first four were effective within approximately 24 hours, while the last two had a slightly delayed effect. Derris (5 per cent. rotenone) and basic copper arsenate had a still more delayed effect, but killed at least 9 out of 10 larvae Dinitro-para-cyclohexylphenol showed little if any toxicity. Both the effective dinitro compounds were repellent, more than half of the larvae refusing to feed on them. Dinitro-o-cresol caused 14 of 20 larvae to moult immediately without feeding; 17 died before the close of the test, 12 of them within 24 hours.

In field tests on tomato, the differences in the percentages of infested fruits given by 9 dusts containing 50 per cent. natural cryolite with different carriers were insignificant, while in tests with sprays in which 8 lb. bentonite clay per 100 U.S. gals. was incorporated as a spreader, lead arsenate and calcium arsenate were superior to synthetic cryolite. Experiments were also carried out on the relative value of insecticidal dusts and baits. Baits containing 10 per cent. synthetic cryolite, calcium arsenate or lead arsenate in maize meal, applied evenly to the foliage by hand, gave good results, and were about as effective as dusts containing the same poisons. The use of baits is economical, since they require no machinery for their application. Field observations on untreated early tomatos showed that about 95 per cent. of the damage occurred prior to and during the time that green tomatos are picked, that damage to the ripe fruit is negligible and that damaged fruit is not necessarily a total loss for canning purposes. There was a rapid decline in infestation on tomatos following the development of silk in nearby maize, which is the preferred food-plant.

Upholt reports that during the period of dormant spraying in 1939–40 considerable injury to peach by the San José scale [*Aspidiotus perniciosus*, Comst.] was observed. Apparently, careless spraying in the previous season had resulted in whole branches being missed, and infestations built up on these limbs killed them in the course of the year. Spraying was carried out more carefully in 1939–40, and the Coccid now appears to be under control. Comstock's mealybug [*Pseudococcus comstocki*, Kuw.], continued to be injurious on apple and some spread of infestation was observed. Late in November,

H. McAlister found pupae of the native parasite, *Clausenia purpurea*, Ishii, among the overwintering egg-masses of *P. comstocki*; this Encyrtid is apparently quite plentiful. Attempts to spray egg-masses with insecticides were not successful as the sprays did not penetrate their cottony covering, but some control was obtained by a high-pressure stream of water.

Cartwright gives the results obtained in 1938–40 in trials of light, highly refined mineral oil as a control for the corn ear worm [*Heliothis armigera*] on sweet maize. The injection of 1 cc. of oil into the tip of each ear just after the silks began to turn brown resulted in 63·6, 70·3 and 69·1 per cent. uninjured ears in the three years, respectively, and the addition to the oil of 1 per cent. pyrethrum and rotenone [*cf.* **28** 184] in 1940 did not increase its effectiveness; the percentages in the controls were 32·1, 24·2 and 25·9, respectively. In investigations on the susceptibility to attack of six supposedly resistant varieties of hybrid sweet maize, the percentage of infested ears ranged from 67·69 to 90·05.

Bondy (F. F.) & Rainwater (C. F.). **Investigations on the Control of Cotton Insects.**—*Rep. S. Carolina Exp. Sta.* **53** (1939–40) pp. 121–127. Clemson, S.C., 1940.

The development since 1923 of work on the control of *Anthonomus grandis*, Boh., on cotton in South Carolina is briefly reviewed. Experiments during 1928–40 showed that the most effective and profitable single treatment is dusting with calcium arsenate at five-day intervals beginning when 10 per cent. of the squares become infested [*cf. R.A.E.*, A **28** 473]. The chief objections to this treatment are that it is expensive and requires special dusting apparatus, that it is often followed by infestation by leaf Aphids [*Aphis gossypii*, Glov.], and that it may cause injury to subsequent crops. In South Carolina, however, no case of soil injury has been observed by the authors during several years of investigations. Tests in South Carolina and Mississippi to determine the amounts of calcium arsenate that would cause injury on different types of soil [*cf.* **26** 328, etc.] have shown that 200 lb. per acre on light sandy soils results in some injury to cowpeas, but that cotton is not damaged until 400 lb. is applied. On heavier soils, 1,600 lb. per acre caused no damage to cotton. Ordinarily, not more than 40 lb. calcium arsenate per acre would be needed per year for weevil control, and it is considered that the risk of consequent soil injury has been greatly exaggerated.

In an attempt to prevent leaf Aphids from increasing to injurious numbers, experiments were carried out on the use of mixtures of calcium arsenate with equal parts of hydrated lime or sulphur. The mixture with lime, applied at the rate of 6–8 lb. per acre, did not cause so large an increase of Aphids and gave satisfactory control of the weevil, but in some years there was still some Aphid injury following its use. In 1939, 0·5 per cent. nicotine was added to this mixture, and enough derris or cubé to give a rotenone content of 0·5 per cent. was added to mixtures of calcium arsenate and equal parts of sulphur or diatomaceous earth. All these combinations were effective in preventing Aphid injury, but rotenone was superior to nicotine. These results were confirmed in 1940, when plots that received undiluted calcium arsenate with 0·5 per cent. rotenone were only slightly more infested by Aphids than the controls and plots receiving calcium

arsenate alone were heavily infested. Those treated with mixtures of calcium arsenate and sulphur or diatomaceous earth with rotenone were less heavily infested than the controls.

ALLEN (N.). **Studies on the Importance and Control of the Tobacco Flea Beetle.**—*Rep. S. Carolina Exp. Sta.* **53** (1939–40) pp. 131–138, 2 figs. Clemson, S.C., 1940.

Investigations on the control of *Epitrix parvula*, F., on tobacco in South Carolina in 1936–40 [*cf. R.A.E.*, A **26** 645; **28** 648, 650] are briefly reviewed. The chief damage is caused to tobacco growing in the field, which may be attacked by the adults at any time during the growing season. The plants are most susceptible to attack soon after transplanting, when they are in a wilted condition, and during the first fortnight in July, when the leaves are maturing. The results indicate that *E. parvula* can be controlled in the plant-bed or in the field by cubé or derris dust mixtures containing 1 per cent. rotenone, which remain effective for two or three days. The dust should be applied at the rate of ½ lb. per 100 sq. yds. of plant-bed. Newly transplanted tobacco can be treated with a small-type "puff duster," and the dust should be used at the rate of 3–5 lb. per acre per application. For larger plants, the dust should be applied when there is little or no wind, at the rate of 8–10 lb. per application, depending on the size of the plants and the severity of the infestation. Experiments have also indicated that a thorough application of a spray of 2 lb. cubé containing 4 per cent. rotenone in 50 gals. water controls the Halticid.

WATTS (J. G.). **Asparagus Beetle Control Studies.**—*Rep. S. Carolina Exp. Sta.* **53** (1939–40) pp. 187–188. Clemson, S.C., 1940.

Extensive defoliation of asparagus by the asparagus beetle [*Crioceris asparagi*, L.] in South Carolina [*cf. R.A.E.*, A **28** 648] occurred during the growing season of 1940. Cage tests with dusts indicated that undiluted calcium arsenate tends to be slightly superior to 0·75 per cent. rotenone against the larvae, but the reverse is true in the case of the adults. When diluted with kaolin, and also when this diluent was supplemented with 10 per cent. bentonite or cottonseed meal, all mixtures containing 10 per cent. or more of calcium arsenate killed more than 85 per cent. of both adults and larvae. The efficiency of various mixtures containing 20 per cent. calcium arsenate is shown in a table. The percentages of adults and larvae killed were 48·86 and 63 when the diluent was lime and 92·05 and 86 when it was kaolin, the difference in each stage being statistically highly significant. Apparently the high alkalinity of lime decreases the toxicity of the mixture in the digestive tract.

In investigations on the effect of arsenic and fluorine on asparagus growth, plots of first-year crowns growing on sandy loam were side-dressed on 2nd June 1939 with calcium arsenate, basic copper arsenate and natural cryolite at rates of 50, 100, 300, 500, 700 and 1,000 lb. per acre. On 15th October 1940, no depression of growth or other toxic effects were visible on asparagus in any of the plots, but there was no grass or weed growth on any of the plots receiving 300 lb. or more per acre of calcium arsenate or basic copper arsenate. The growth of weeds and grass was not affected by natural cryolite at any of the rates used.

Hedden (O. K.) & Merrill (R. M.). **Experiments in the Use of Vapor-spray Equipment.**—*Circ. U.S. Dep. Agric.* no. 598, 19 pp., 7 figs. Washington, D.C., 1941.

The investigations described in this paper were carried out with a boiler apparatus, a detailed description of which is given, that delivers a jet of water vapour into which an insecticide or fungicide is introduced before it leaves the nozzle. Laboratory tests showed that sprays produced by this method were more finely divided and evenly dispersed than those produced by ordinary hydraulic spray machinery, and although the vapour did not appear to equal ordinary sprays in carrying power, the force was sufficient to ensure penetration and coverage of most foliage of normal density, with the additional advantage that it was able to cover and wet surfaces quickly.

The following is based on the authors' summary. Experiments indicate that the water used for spraying can be reduced by 33–50 per cent. by the use of vapour-spray equipment, but the cost of operating a portable oil burner of suitable size would probably offset this advantage. Observation of the results of applying various materials with vapour-spray apparatus indicates that sulphurs are generally improved in fungicidal action and adhesive qualities, but there is also evidence that the utilisation of the heat of the spray liquid in the production of lime-sulphur from a concentrate of lime and sulphur injected into the vapour line is too unreliable to be suitable for spray work. It is believed that under certain conditions some polysulphides that are injurious to foliage may be produced by incomplete chemical reactions of these materials while heated in the spray hose. Control of apple scab, cherry leaf spot and peach leaf curl when various forms of sulphur were applied by this method was in practically all cases equal or superior to that obtained when they were applied in the ordinary way. Suitable coverage was secured with small amounts of the sulphur compounds, as well as with a smaller amount of spray liquid. Sprays, such as liquid lime-sulphur, that irritate the skin were applied with considerably less discomfort to the operator, as there appeared to be less tendency for the drift to coat the face and hands.

Certain materials appeared to be entirely unsuited for use in vapour-spray equipment. Thiodiphenylamine (phenothiazine), free nicotines and Bordeaux mixture did not appear able to withstand the heat necessary to produce vapour, without serious deterioration. Fixed nicotines appeared to resist the action of heat somewhat better than free nicotines. All insoluble copper compounds tested were injurious to foliage when applied with this apparatus. It was also unsatisfactory for the application of lead arsenate for the control of the codling moth [*Cydia pomonella*, L.] since the light, thin coating of material that was obtained did not protect the apples. As much toxic material was apparently required to give adequate protection as when an ordinary sprayer was used. An advantage possessed by the vapour sprayer in damp weather was the ability of the finely divided spray to evaporate and dry rapidly after condensation. This enabled the materials to adhere better to fruit or foliage sprayed during very humid weather or shortly before a shower. A mechanical characteristic that is a considerable disadvantage is the need for a heavy heat-resistant hose with rugged couplings capable of withstanding rough field usage when operating at high temperatures. The spray produced at the nozzle is very finely divided and consequently does not carry quite so well under

windy conditions as that produced by the ordinary hydraulic sprayer. Practical spraying for pest control requires a sprayer that is very versatile in its use of materials, and among the several insecticides and fungicides applied in these experiments, sulphur and fixed nicotine compounds were the only two that gave much promise of producing uniformly satisfactory results with the vapour-spray apparatus.

Toxicity of Ammonia, Chlorine, Hydrogen Cyanide, Hydrogen Sulphide, and Sulphur Dioxide Gases.—*Contr. Boyce Thompson Inst.* **11** no. 5 pp. 325–385, 15 figs., 54 refs. Yonkers, N.Y., 1940.

An account is given of a series of co-operative tests in which a survey was made of the relative toxicity to various forms of plant and animal life of five common industrial gases, ammonia, chlorine, hydrogen cyanide, hydrogen sulphide and sulphur dioxide, selected because of their chemical properties, physiological action and occurrence in industrial atmospheres. The apparatus used permitted a constant flow of the gas at definite concentrations. The first section, by S. E. A. McCallan and C. Setterstrom (pp. 325–330), deals with the general methods employed and correlations of the results on all organisms, and the second, by McCallan and F. R. Weedon (pp. 331–342), with toxicity to fungi and bacteria. In the third paper (pp. 343–356), dealing with the effect on green plants, N. C. Thornton and Setterstrom show that the order of toxicity of the gases to the leaves, and the order of effect of the gases on the pH of tomato leaves, was $Cl_2 > SO_2 > NH_3 > HCN > H_2S$, and that visible injury to plants was correlated with the effectiveness of Cl_2, SO_2, NH_3 and H_2S in bringing about a change in the pH; in the case of HCN, the injury to the plant was always greater than the change in pH of the treated tissue would indicate. L. V. Barton (pp. 357–363) records that moist seeds were much more sensitive to these gases than dry ones. Delay in germination due to treatment was the principal effect noted in moist seeds; this was sometimes accompanied by a reduction in the percentage that germinated, and in some instances all the seeds were killed. At concentrations of 1,000 and 250 parts per million, HCN and H_2S had no effect on the percentage germination, but delayed the appearance of seedlings under some conditions; NH_3 and Cl_2 were more toxic and SO_2 was most toxic under the conditions of this experiment. Exposure of dry seeds of radish did not reduce the percentage germination, but reduction resulted when dry rye seeds were exposed to Cl_2 or SO_2 for 16 hours. Delay in germination of both radish and rye seeds resulted from exposure for this period to all the gases except H_2S. Weedon, A. Hartzell and Setterstrom (pp. 365–385) describe tests on house-flies (*Musca domestica*, L.), mice and rats. Toxicity curves are given for various concentrations of the different gases. The order of decreasing toxicity of the gases to both flies and rodents was HCN, H_2S, Cl_2, SO_2 and NH_3. The rats and mice were more resistant to HCN than were the flies, indicating the possibility that a low uniform concentration of HCN that would be effective against insects might be maintained in fumigation with little or no hazard to warm-blooded animals.

Hurst (H.). **Insect Cuticle as an asymmetrical Membrane.**—*Nature* **147** no. 3726 pp. 388–389, 6 refs. London, 1941.

Results similar to those obtained on the permeability of the lipoid layer of the insect cuticle [*R.A.E.*, A **29** 239–241] have since been

obtained with the outer cutinised layers of a number of plant epidermal membranes, the physical and chemical properties of which are said to resemble those of the lipoid layer in insects. This suggested that induced penetration of polar substances might take place with simpler artificial membranes, and the permeability of thin rubber was found to be similar. The importance of the physico-chemical relation between a membrane and the permeating substance in determining whether the permeability of the membrane to the substance might be modified by the introduction of other components is stressed by the citation of a number of examples, and as an illustration of the practical application of the findings to the control of insects, it is stated that though a mixture of ethyl alcohol and kerosene is very toxic to *Calliphora* larvae [*loc. cit.*], mixtures of ethyl alcohol with oleic acid or castor oil are only slightly toxic.

Insect cuticle possesses a high degree of asymmetry depending on the association between the external hydrofuge lipoid layer and the internal hydrophil protein-chitin complex. The way in which this asymmetry affects the permeability of the whole cuticle and is modified in different insects by the relative distribution and physical properties of the soluble and insoluble components of the cuticle framework is discussed.

O'Kane (W. C.), Glover (L. C.), Blickle (R. L.) & Parker (B. M.). **Penetration of certain Liquids through the Pronotum of the American Roach. Studies of Contact Insecticides XIV.**—*Tech. Bull. N. H. agric. Exp. Sta.* no. 74, 16 pp., 8 figs. Durham, N.H., 1940.

The results are given in this report of studies designed to measure the rate and amount of penetration of liquids through a detached piece of the integument of an insect observed in a specially designed apparatus. The apparatus and procedure are described. The integument used was the pronotum of a cockroach [*Periplaneta americana*, L.] and the liquids studied were mostly alcohols and oils. Penetrations are given in tables. No conclusions are drawn.

Jack (R. W.). **Report of the Division of Entomology [Southern Rhodesia] for the Year ending 31st December, 1939.**—35 pp. typescript. [Salisbury, S. Rhod.] 1940.

Nearly half this report on insect pests in Southern Rhodesia in 1939 is concerned with insects of medical and veterinary importance ; other sections deal with locusts, pests of individual crops, stored products and miscellaneous plants, pests intercepted during the year, and inspections of warehouses, farm premises and fields carried out under the Tobacco Pest Suppression Act, 1933 [*cf. R.A.E.*, A **21** 487].

During the wet season of 1938–39, there was some breeding by *Nomadacris septemfasciata*, Serv., mostly in low-lying areas in 22 out of the 32 districts of Southern Rhodesia [*cf.* **28** 139] ; the resultant swarms, which were not numerous, appeared in April 1939 and remained inactive until September, after which they tended to move to the south and east. In December 1939, Southern Rhodesia was invaded by swarms from the east and north, which did considerable

damage to crops. There was extensive egg-laying, again in low-lying areas. The control measures taken were designed for the protection of crops. Hoppers were destroyed by beating in populous native areas, and by spraying, where the population was less dense. Moderately successful results were obtained with bait purchased from the Union of South Africa ; it is suggested that in Southern Rhodesia its usefulness is reduced by the wet weather, with heavy tropical showers, that occurs there during the hopper season in January–February.

In the sections dealing with pests of the main crops, it is stated that *Busseola fusca*, Fuller, was the most important pest of maize and caused extensive damage during April and May in a number of districts. Maize that was sown early owing to the early onset of the rains was badly attacked in December in certain areas. Severe lodging of maize plants in April–June, hitherto attributed to larvae of *Eulepida mashona*, Arrow, is now believed to be due to other causes. Seedling maize in two districts was heavily attacked by *Tanymecus destructor*, Mshl., in early December. On tobacco, *Myzus persicae*, Sulz., and the rosette disease transmitted by it were reported in several districts, and leaf-curl and its vector, *Bemisia rhodesiaensis*, Corb., in two. Newly transplanted tobacco in one locality was severely injured in early December by adults of the Dynastids, *Heteronychus inops*, Pér., *H. sanctaehelenae*, Blanch. (*arator*, auct.), *H. puncticollis*, Jack, *H. licas*, Klug, and *H. consimilis*, Kolbe, of which the first was the most important. *Analeurops cuthbertsoni*, Mshl., seriously damaged the young leaves of seedling tobacco in mid-December. The Galerucid, *Exora discoidalis*, Jac., was the most important pest of sunn hemp [*Crotalaria juncea*], especially on crops germinating in early December. A fungous disease of the pods caused by *Hematospora* sp. and associated with feeding by *Aspilocoryphus fasciativentris*, Stål, was observed in two districts, but it is not known whether this Lygaeid is concerned in its dissemination. The young growth of tea on one estate was injured by *Scirtothrips aurantii*, Faure, during the late dry season ; partial control was maintained by means of sprays containing colloidal sulphur or lime-sulphur.

Papers noticed by Title only.

Waloff (Z. V.). **The European Migratory Locust** [*Locusta migratoria*, L.] **in the British Isles.**—*S. East. Nat.* **46** pp. 59–62. London, 1941. [*Cf. R.A.E.*, A **29** 322.]

Moriyama (T.). **Studies on the lethal Effects of Insecticides. 2. Historical Review of the Studies of the lethal Mechanism of Derris on Insects.** [*In Japanese.*]—*Formosan agric. Rev.* **37** no. 4 pp. 257–280. Taihoku, 1941. [*Cf. R.A.E.*, A **29** 88.]

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CHACARAS E QUINTAES (SÃO PAULO): Indices to Vols. X, XI, XII, XIV and XLII, No. 3.

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Vols. I–VI (1916–21); VII (1922) Nos. 1–5; VIII (1923) Nos. 2–5; IX (1924) Nos. 1, 4–6.

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Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.

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Bulletin: 2, 6, 22 and 28. Circular: 1 to 3, 12, 15 to 18 and 20.

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